Service Manual

Accutorr® PLUS

mindray™
NORTH AMERICA

Service Manual

Datascope
Accutorr® PLUS

mindray
NORTH AMERICA

INTRODUCTION

Chapters

1. Operation
2. Theory of Operation
3. Specifications
4. Repair Information
5. Schematics
6. Parts
7. Calibration
8. Preventive Maintenance

A complete, detailed table of contents begins on page iii. Also, on the first page of each chapter a table of contents for that chapter is provided.

FOREWORD

This Service Manual (P/N 0070-00-0429) is intended as a guide, for technically qualified personnel, to use during repair and calibration procedures for the Accutorr Plus (part number 0998-00-0444-XX). **NOTE:** See the serial number label on the rear panel of the unit for part number identification. This manual also includes information on the Recorder and Predictive Temperature Modules.

The information in this manual has been divided into the eight chapters listed above.

This publication may have been updated to reflect product design changes and/or manual improvements. Any such changes to this manual would be accomplished by supplying replacement pages and instructions for inserting or affixing them into the manual.

NOTE

Unauthorized servicing may void the remainder of the warranty. Check with the factory or with a local authorized Datascope representative to determine the warranty status of a particular instrument.

NOTE: This product is year 2000 compliant.

This page intentionally left blank.

TABLE OF CONTENTS

This page intentionally left blank.

1.0 OPERATION

CONTENTS OF THIS CHAPTER Page

1.1 INTRODUCTION

This section of the Service Manual (P/N 0070-00-0429) is provided as a review of the Accutorr Plus NIBP, the Accutorr Plus NIBP with Trend Screen and the Accutorr Plus NIBP with Trend Screen and SpO_2 functions and operation. The reader is encouraged to refer to the Operating Instructions, P/N 0070-00-0428, for more complete details.

This page intentionally left blank.

1.2 CONTROLS AND INDICATORS

This section of the Service Manual identifies and describes each control and display of the Datascope Accutorr Plus NIBP, the Accutorr Plus NIBP with Trend Screen and the Accutorr Plus NIBP with Trend Screen and SpO_2. For step-by-step operating instructions see Chapter 1.3, "Operation".

The following is a list of all controls, connectors and indicators, their item number and the page number. The item number refers to the call outs on the drawings within this chapter. The page number refers to the page where the description of the item can be found.

1.2.1 Front Panel

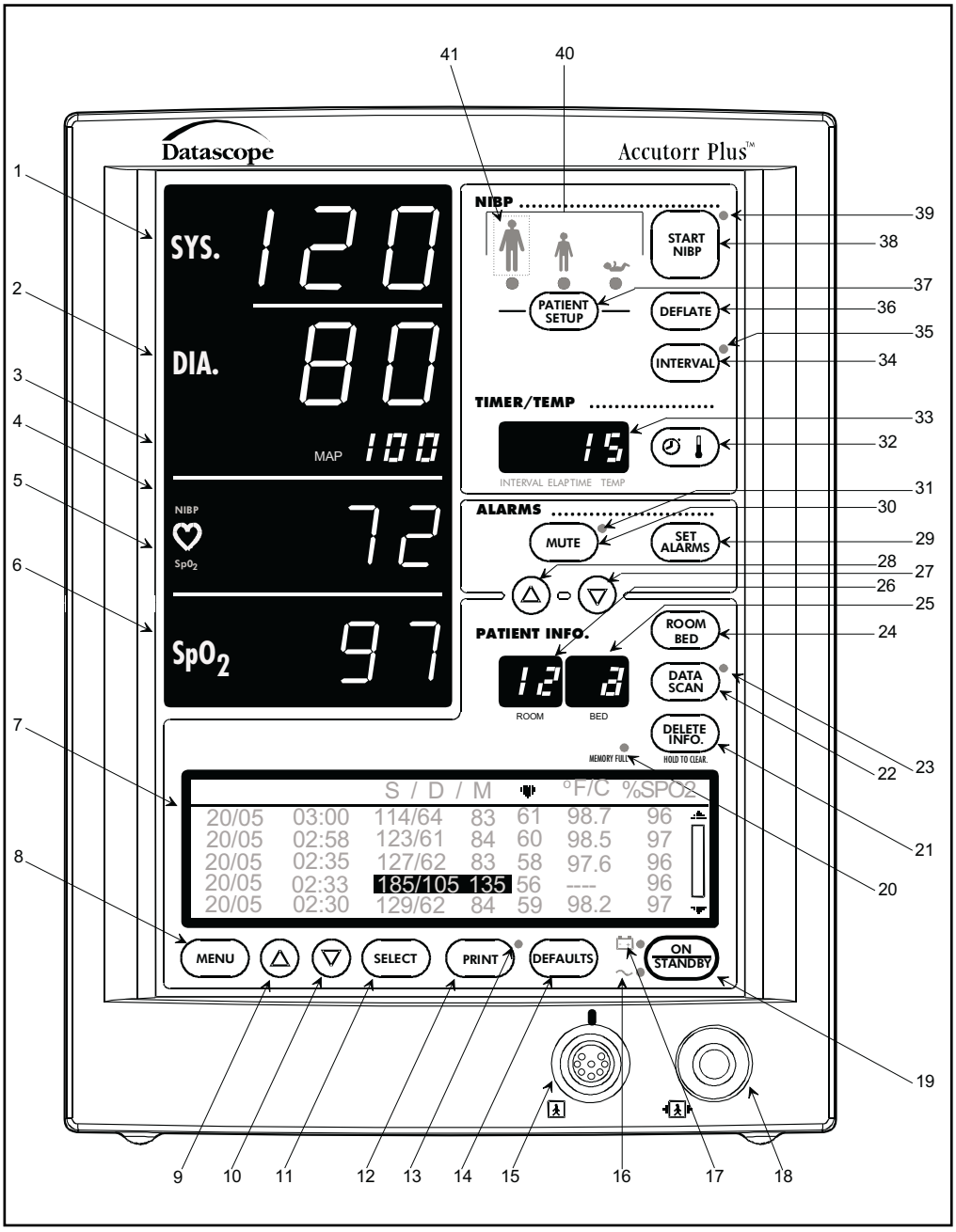


Figure 1-1 Front Panel - Accutorr Plus NIBP with Trend Screen and Datascope SpO_2

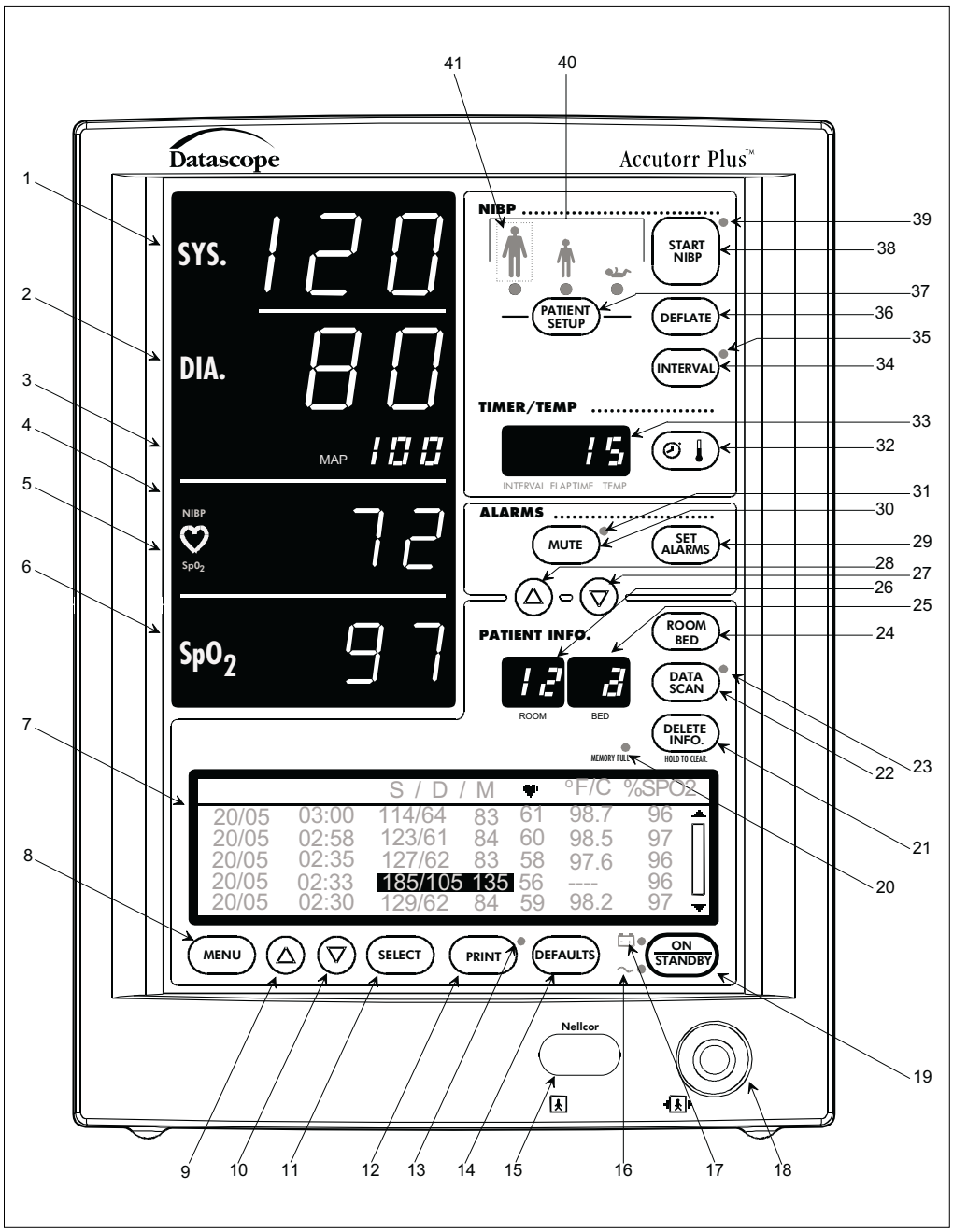


Figure 1-2 Front Panel - Accutorr Plus NIBP with Trend Screen and Nellcor® or Masimo SpO_2

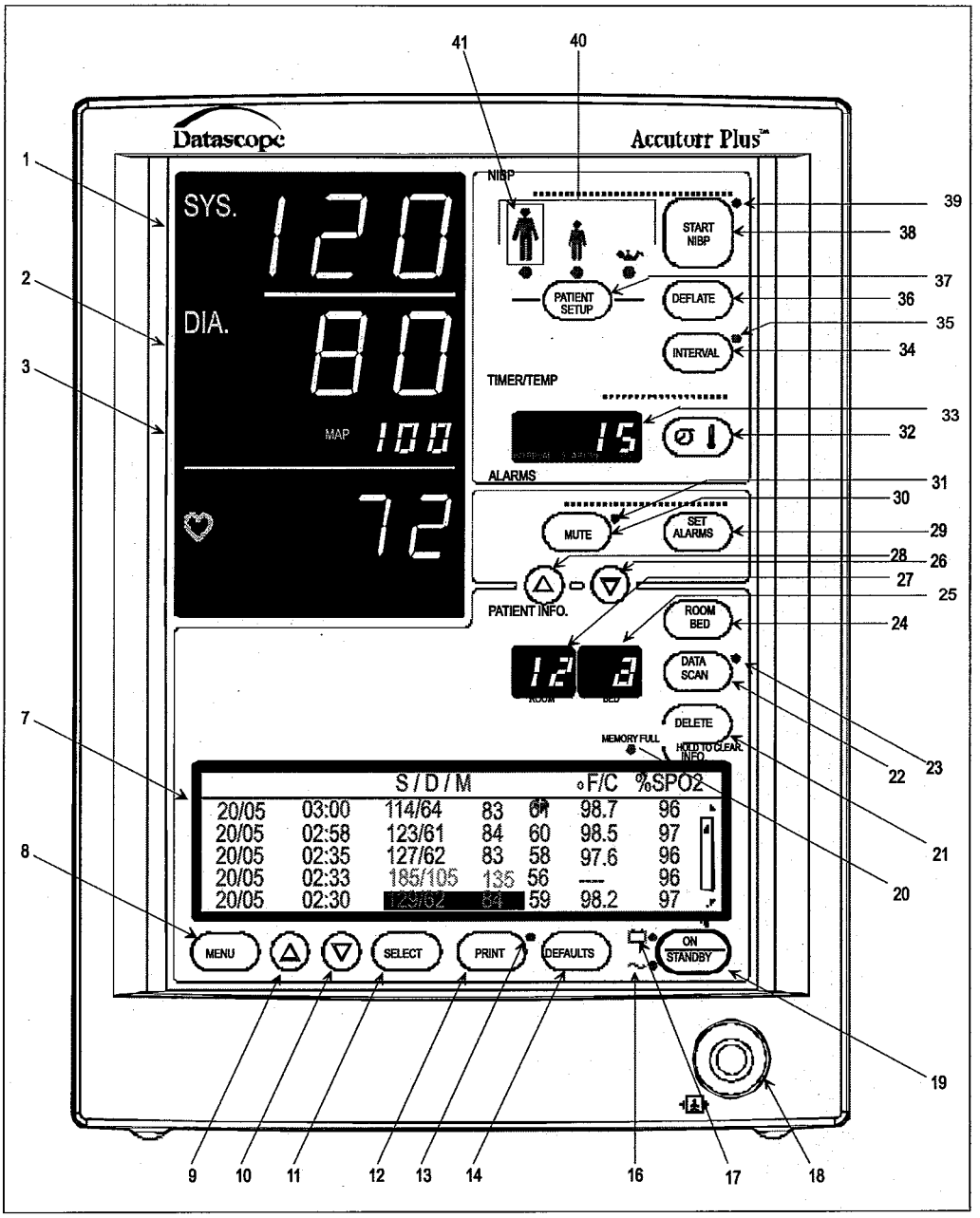


Figure 1-3 Front Panel - Accutorr Plus NIBP with Trend Screen

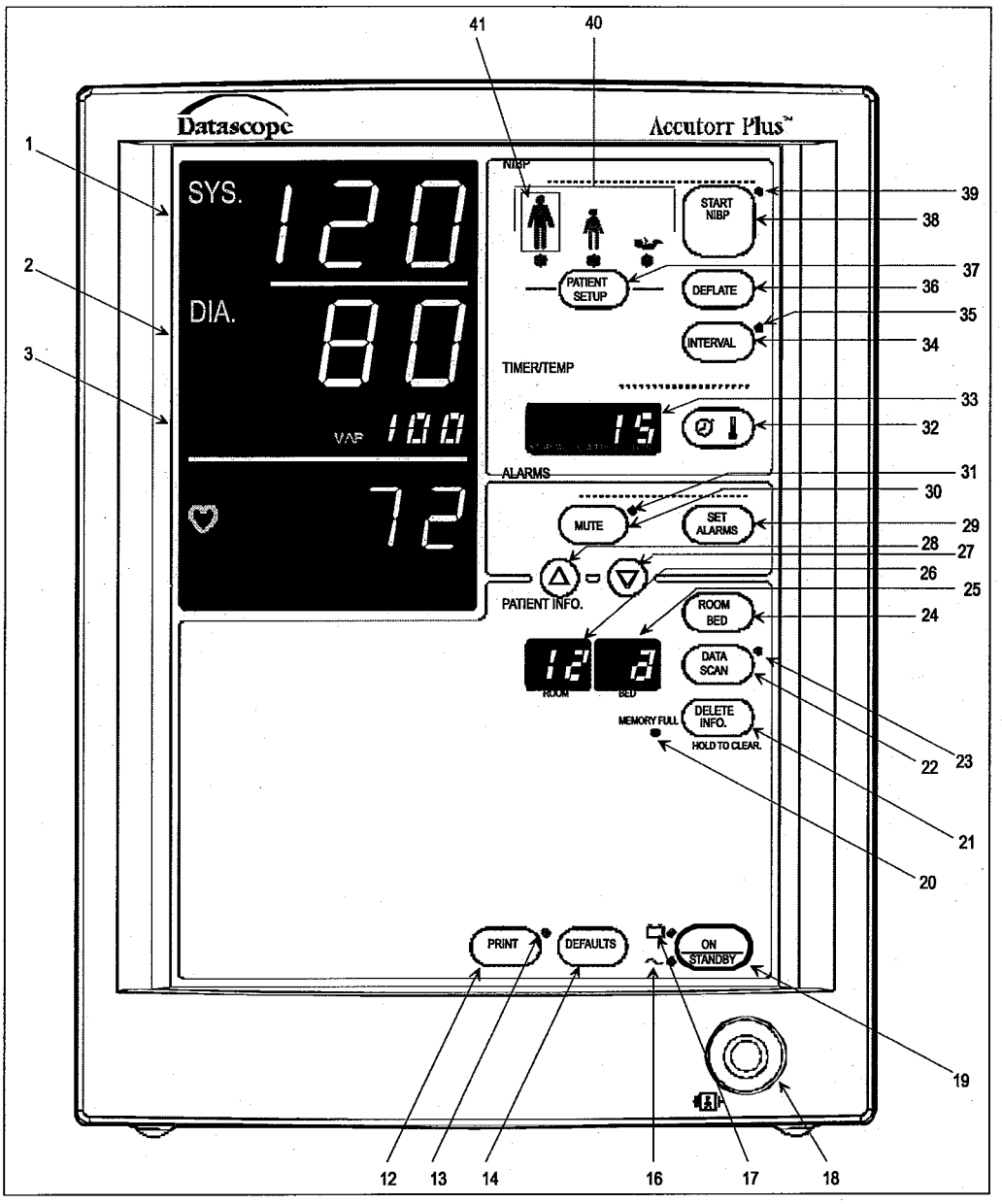


Figure 1-4 Front Panel - Accutorr Plus NIBP

1. **NIBP Systolic Display**

   Displays the systolic blood pressure data from NIBP measurements. It is also used to display NIBP error codes and systolic alarm limits.

2. **NIBP Diastolic Display**

   Displays the diastolic blood pressure data from NIBP measurements. It is also used to display diastolic alarm limits.

3. **NIBP MAP Display**

   Displays the mean arterial pressure (MAP) information from NIBP measurements. During a measurement, it will display the cuff pressure. It is also used to display the MAP alarm limits and the inflation pressure when selecting the initial inflation pressure.

4. **Pulse Rate Display**

   Displays the pulse rate information from either the NIBP measurement or the SpO2 reading (Accutorr Plus model with SpO_2). It is also used to display pulse rate alarm limits.

5. **NIBP/SpO_2 Pulse Rate Indicator**

   When the pulse rate displayed is based on an NIBP measurement, then NIBP is illuminated. When the pulse rate displayed is based on an SpO_2 measurement (Accutorr Plus model with SpO_2), then SpO_2 is illuminated.

6. **SpO_2 Display (Accutorr Plus model with SpO_2)**

   Displays the %SpO_2 measurement information. This area is also used to display the %SpO_2 alarm limits.

7. **Liquid Crystal Display (LCD) (Accutorr Plus models with Trend Screen)**

   The Liquid Crystal Display (LCD) is used to display previous measurements (trend list) for the selected patient, or a menu that controls the beep volume and alarm volume.

8. **Menu Key (Accutorr Plus models with Trend Screen)**

   This key is used to toggle between the trend list screen and the menu screen in the LCD. When the back light in the LCD is off, pressing this key turns it on. This key is also used to adjust the LCD contrast. Press and hold the key for two beeps to enter the adjustment mode. Use the Arrow keys (9 and 10) to change the contrast.

9. **LCD Up Arrow Key (Accutorr Plus models with Trend Screen)**

   This key is used to scroll the trend data so that more recent measurements are displayed in the LCD. When the back light in the LCD is off, pressing this key turns it on. This key is also used to adjust the LCD contrast when in the adjustment mode. Use the Menu key (8) to enter the adjustment mode.

10. **LCD Down Arrow Key (Accutorr Plus models with Trend Screen)**

    This key is used to scroll the trend data so that older measurements are displayed in the LCD. When the back light in the LCD is off, pressing this key turns it on. This key is also used to adjust the LCD contrast when in the adjustment mode. Use the Menu key (8) to enter the adjustment mode.

11. **Select Key (Accutorr Plus models with Trend Screen)**

    When the menu screen is displayed in the LCD, this key is used to select the menu items. When the back light in the LCD is off, pressing this key turns it on.

12. **Print Key**

    Press this key to print all stored information for the selected patient. Press to stop a printing that is in process. Press and hold this key (2 single beep tones, approx. 3 seconds) to change the print mode between Continuous and Request. When in the Continuous mode, the PRINT Indicator LED is illuminated. When loading in a new roll of recorder paper, press this key to feed the paper through the printer.

13. **Print Indicator**

    This indicator is illuminated when continuous printing of measurements is selected.

14. **Defaults Key**

    Press and hold this key (2 single beep tones, approx. 3 seconds) to reset all parameters back to the hospital default settings. This includes alarms, inflation pressure, interval, etc... When in the process of making a change to a setting, you can return to the original setting by momentarily pressing this key. To enter the User Configuration, press and hold this key (1 beep tone), while turning the unit on. See section 1.3.15 for details on default settings and User Configuration.

15. **SpO_2 Connector (Accutorr Plus model with Datascope, Nellcor® or Masimo SpO_2)**

    This connector is used to attach Datascope, Nellcor® or Masimo SpO_2 sensors.

16. **AC Power Indicator**

    This green LED illuminates whenever AC power is applied to the unit.

17. **Battery Indicator**

    This green LED illuminates whenever the unit is operating on battery power. The LED will flash when the battery requires charging. When the LED begins flashing, approximately 30 minutes of battery time remain on the Accutorr Plus NIBP (20 minutes on the Accutorr Plus NIBP with Trend Screen and 10 minutes on the Accutorr Plus NIBP with Trend Screen and SpO_2).

18. **NIBP Connector**

    This connector is used to attach specified NIBP hoses.

19. **On/Standby Key**

    This key is used to activate the unit, enabling it to begin taking measurements. The unit does not have to be "ON" for the internal battery to charge. However, the unit does need to be plugged into an AC receptacle for the battery to be charging.

20. **Memory Full Indicator**

    This LED indicator flashes when 80 - 99 of the 100 available entries of trend are used. This LED is on continuously when 100 are used. Delete measurements manually using the DELETE INFO. key or the unit will automatically delete the oldest measurement for the current patient. **NOTE:** The unit will also automatically delete data that is 24 hours old.

21. Delete Info. Key

Press the Data Scan key to enable the Delete Info. key (Accutorr Plus without Trend and SpO_2 only). Once enabled, press and hold this key (1 beep tone, approx. 3 seconds) to delete the most recent reading when it is displayed. When displaying any measurement, press and hold this key (2 beep tones, approx. 6 seconds) to delete all information for the currently selected patient. Press and hold at power up to delete all information for all patients.

22. Data Scan Key

Press this key (1 beep tone) to view previous measurements for the selected patient on the Accutorr Plus NIBP and to enable the Delete Info. key (Accutorr Plus without Trend and SpO_2 only). The LED indicator next to the key illuminates. On the Accutorr Plus NIBP, use the Patient Info. Up & Down Arrow keys (27 & 28) to scroll through the stored measurements for the selected patient. On all models of the Accutorr Plus, press and hold this key (2 beep tones, approx. 6 seconds) to scan all of the rooms and beds for stored measurements. Press the Data Scan key again to stop on a particular room/bed. Press the Data Scan key again to exit this view mode.

23. Data Scan Indicator

This LED indicator is illuminated when viewing prior data.

24. Room/Bed Number Key

Press this key to change the displayed Room/Bed. After pressing this key use the Patient Info. Up & Down Arrow keys (27 & 28) to change the Room/Bed. This key is also used when selecting a User Configuration item.

25. Bed Letter Display

This display is used to show the current patient bed letter. It is also used to display status codes for NIBP, SpO_2 and Temperature and to display User Configuration items.

26. Room Number Display

This display is used to show the current patient room number. It is also used to display status codes for NIBP, SpO_2 and Temperature, indicates which alarm is being set (Hi or Lo), and displays a User Configuration item.

27. Patient Info. Down Arrow Key

This key is used to decrement the alarm limits when they are shown on the LED displays and to decrement the hours, minutes, month, day and year in the clock set mode. This key is also used to change the Room/Bed, to scroll through previous data and to change initial inflation pressure.

28. Patient Info. Up Arrow Key

This key is used to increment the alarm limits when they are shown on the LED displays and to increment the hours, minutes, month, day and year in the clock set mode. This key is also used to change the Room/Bed, to scroll through previous data and to change initial inflation pressure.

29. Set Alarms Key

This key is used to select the NIBP and SpO_2 (Accutorr Plus model with SpO_2) alarms to be changed. Repeated presses of this key sequences through the choices of Systolic Hi, Systolic Lo, Diastolic Hi, Diastolic Lo, Map Hi, Map Lo, Pulse Rate Hi, Pulse Rate Lo, SpO_2 Hi and SpO_2 Lo. After the last available parameter, the next press returns the unit to normal operation. Once the desired parameter is flashing, use the Patient Info. Up & Down Arrow keys (27 & 28) to increment or decrement the alarm values.

30. Mute Key

Press this key (one beep tone), to silence the current alarm tone for 2 minutes. If a new alarm is detected during the 2 minutes, a new alarm tone will sound. Press and hold (2 beep tones, approx. 3 seconds) to permanently silence all alarm tones. Press this key again (1 beep tone), to activate alarm tones.

31. Mute Indicator

This LED indicator is illuminated when the alarm tone has been silenced permanently and when the alarm volume is set to OFF.

32. Timer/Temp Key

This key is used to switch between viewing the elapsed time or the temperature in the Interval/Elap. Time/Temp Display. When viewing stored measurements on the Accutorr Plus NIBP, press this key to switch between viewing the temperature and time of the measurement.

33. Interval/Elap. Time/Temp Display

This displays the time, in minutes since the last successful NIBP measurement (Elap. Time is illuminated). When the Interval key is pressed, the Elap. Time changes to the current Interval setting (Interval is illuminated). When the Predictive thermometer probe is removed from its holder, the Elap. Time changes to Temp (Temp is illuminated). Either “85.0" (F) or ”29.4" (C) will display; this is an internal self test feature. As the Predictive thermometer is taking a measurement, the display will flash as the number increases. When the final temperature measurement is determined, the display will no longer flash and a beep tone is generated. When the AccuTemp IR thermometer is used, the temperature is not displayed until after the measurement is taken and the thermometer is placed back into its holder. This display will also show the current time and date when setting the clock.

34. Interval Key

Press to enter the set time interval mode. An interval is set for automatic NIBP measurement cycles. To sequence through the interval choices of: OFF (——, when set to display graphics), CONT (Continuous), 1, 2.5, 5, 10, 15, 20, 30, 60, 120 and 240 minutes, repeatedly press the Interval key. When the desired interval is displayed in the Interval/Elap. Time/Temp Display the TIMER/TEMP key may be pressed to enter the interval setting or, the displayed setting will be entered when 15 seconds have elapsed without pressing the Patient Info. Up or Down arrow keys (27 & 28).

35. Interval Indicator

When an interval setting is selected, except for Off, the Interval Indicator flashes. When the interval mode is activated the Interval Indicator illuminates continuously.

36. Deflate Key

Press this key to stop an NIBP measurement that is in progress and deflate the cuff. A new measurement cycle will not be allowed for 10 seconds following the use of this key. The Start NIBP LED indicator is illuminated when a new measurement can begin. Press this key while in the interval mode to suspend the interval operation.

37. Patient Setup Key

Press this key (1 beep tone) to select the patient size. Each time the key is pressed the patient size will change. The choices will cycle from Adult, Pediatric, Neonate, Adult, Pediatric, Neonate, etc...

PRECAUTION: *It is the users responsibility, when changing the room/bed, to assure the patient size and alarm settings are set as required.*

This key is also used to view the cuff inflation pressure for an NIBP measurement. Press and hold (2 beep tones, approx. 3 seconds) to display the current inflation pressure in the MAP display. Use the Patient Info. Up & Down Arrow keys (27 & 28) to change the cuff pressure.

38. Start NIBP Key

Press this key to initiate an NIBP measurement. If a measurement is already in progress, a new measurement can not be initiated until a minimum of 10 seconds after the end of the one in progress (30 seconds when in the interval mode). The Start NIBP LED indicator is illuminated when a measurement can begin.

39. Start NIBP Indicator

This LED indicator is illuminated when the Accutorr Plus is ready to initiate an NIBP measurement.

40. Patient Size Indicators

One of theses LEDs illuminates to indicate the selected patient size.

41. Hidden Key

To enter the Service Diagnostics mode, press and hold this key (1 beep tone) while the Accutorr Plus is powering on and running the self tests (all “8"’s displayed in the LEDs). The Service Diagnostics mode is used to initiate various performance tests that are to be done by technical service personnel only. To exit Service Diagnostics, power down the Accutorr Plus by pressing the On/Standby key.

1.2.2 Rear Panel

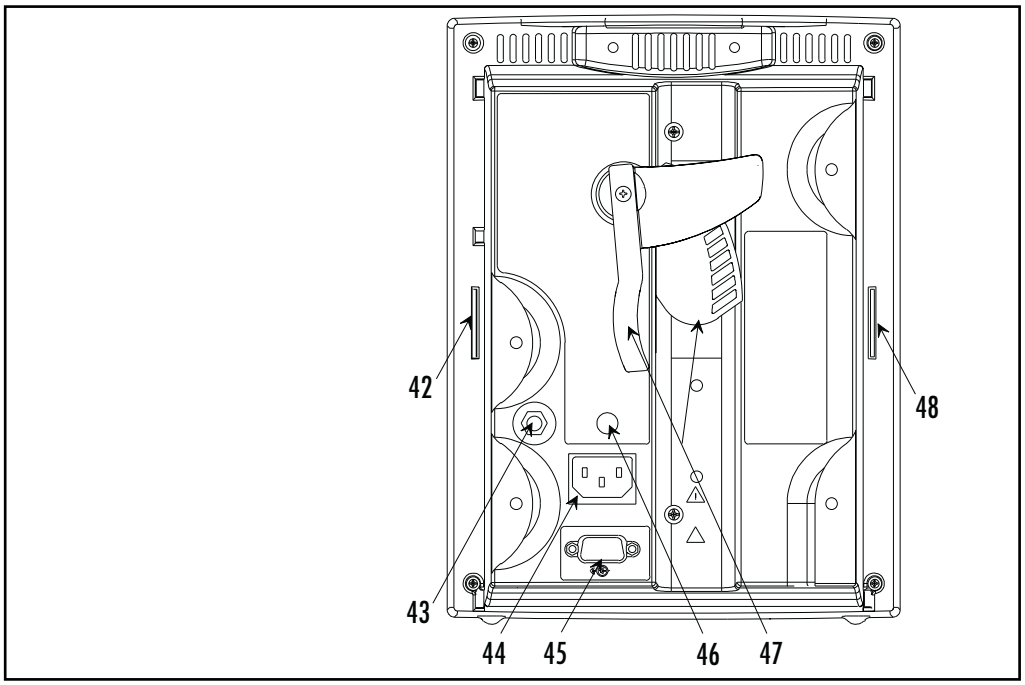


Figure 1-5 Rear Panel - All Units

42. **Thermometer Module Connector**

    Used to attached one of the optional Datascope thermometer modules (PTM or AccuTemp IR).

43. **Equipotential Lug**

    Provides equipotential bonding between hospital equipment.

44. **AC Power Connector**

    Allows for A.C. power cord connection.

45. **Communications Connector**

    Provides compatible communications to external devices and hospital's information system.

46. **Datascope Connector**

    Used by Datascope Technical Service Personnel.

47. **Pole Mounting Handle and Cam**

    Provides the ability to quickly mount the Accutorr Plus to a rolling pole.

48. **Recorder Module Connector**

    Used to connect the optional Datascope recorder module.

1.2.3 Predictive Thermometer Module (PTM)

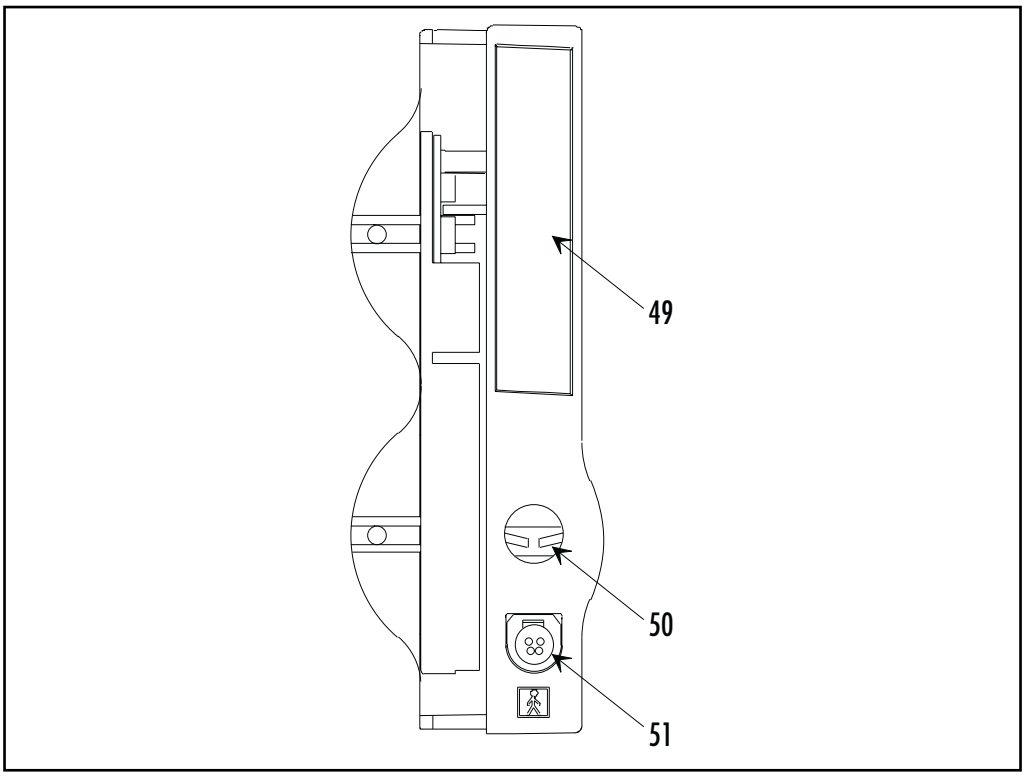


Figure 1-6 Predictive Thermometer Module

49. **Probe Cover Holder**

    Used to store a box of probe covers.

50. **Probe Chamber**

    Used to store the temperature probe when not in use.

51. **Probe Connector**

    Used to connect the thermometer probe to the PTM module.

1.2.4 Recorder Module

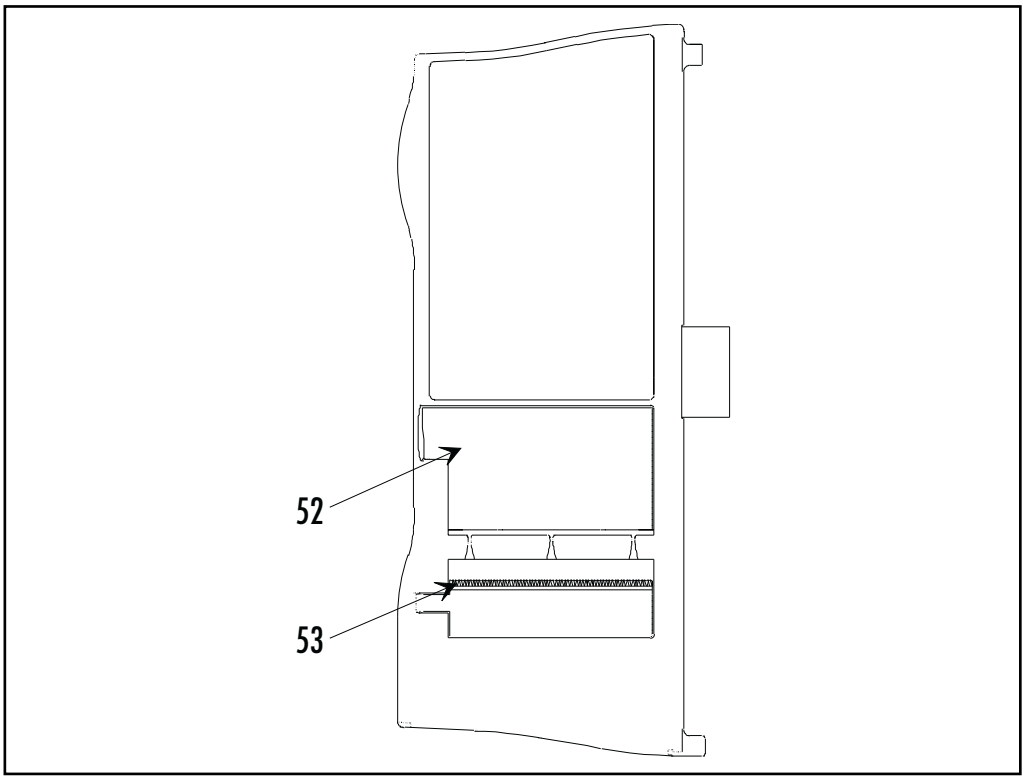


Figure 1-7 Recorder Module

52. Paper Door

Open this door when loading recorder paper.

53. Paper Tear Edge

The paper tear edge is used to tear off printed recorder strips. The edge can be removed in the event of a paper jam that needs to be cleared.

This page intentionally left blank.

1.3. OPERATION

This section of the Service Manual provides guidelines and step-by-step instructions for proper operation of the Accutorr Plus NIBP, Accutorr Plus NIBP with Trend Screen, and the Accutorr Plus NIBP with Trend Screen and SpO_2. The numbers in parentheses ( ) refer to the items described in Section 1.2, "Controls and Indicators". When a described feature refers to a particular model, it will be noted. When the name Accutorr Plus is used, it refers to all 5 models.

1.3.1 SETTING-UP / TURNING POWER ON

1. Before turning the power on, check the rear panel for voltage requirements. Confirm proper voltage is available.

2. Before turning the power on, connect any required modules (recorder, thermometer). For instructions on connecting modules, see section 1.3.17.

   Upon installation of any optional modules, a test is required after power up (step 5). For the recorder, press the print key and the recorder will feed the paper to verify proper function. For the Predictive thermometer, remove the probe from its holder and verify 85.0 (29.4) appears in the Interval/Elap. Time/Temp display.

3. If additional communications capabilities are required, attach a communications interface cable to the rear panel COMMUNICATIONS CONNECTOR (45) and to the corresponding interface connector on the peripheral instrument.

4. Attach the AC power cord into the rear panel AC POWER CONNECTOR (44) and into a grounded (3-prong) Hospital Grade AC receptacle. Do not use an adapter to defeat the ground. The green AC POWER INDICATOR (16) illuminates, indicating AC power has been applied. The internal battery charges automatically when AC power is applied.

   WARNING: *When attached to other products ensure that the total chassis leakage currents of all units (combined) do not exceed 100μA.*

5. Press the ON/STANDBY key (19) to activate the unit. If it is required to enter the User Configuration mode, press and hold the DEFAULTS key (14) while the unit is powering on. See section 1.3.15 for more details on the User Configuration mode.

6. The unit begins a countdown from 20 and performs internal diagnostic tests. Any status codes are displayed in the appropriate LED. See section 1.3.16 for a list of status codes. At the end of power up, all of the displays (including the LCD on the Accutorr Plus models with Trend Screen) illuminate and then blank, except the Bed Letter and Room Number displays (25 & 26) which does not blank. A beep tone will sound during the power up sequence to confirm the operation of the audio indicator. If the time and date need to be set, see section 1.3.13 for instructions.

7. On an Accutorr Plus models with Trend Screen, adjust the contrast on the LCD if necessary. To adjust the contrast, press and hold the MENU key (8) (2 beep tones, approx. 3 seconds). Use the LCD UP & LCD Down ARROW keys (9 & 10) to adjust the contrast. See section 1.3.8, Setting the LCD Contrast, for more details.

1.3.2 PATIENT SETUP AND ROOM/BED ASSIGNMENT

1.3.2.1 Selecting the Patient Size

The Patient Size is selected using the PATIENT SETUP key (37).

1. Press the PATIENT SETUP key (37) to select the Patient size. Three choices are available: Adult, Pediatric and Neonate. Each time the key is pressed the patient size changes. The indicator under the graphic of the patient size illuminates to indicate which size is selected. The factory default setting for the Patient size is Adult. See section 1.3.15, "User Configuration" to set a custom default setting. **NOTE:** Do not press and hold the PATIENT SETUP key to change the patient size. Pressing and holding this key, enter the initial cuff inflation pressure change mode.

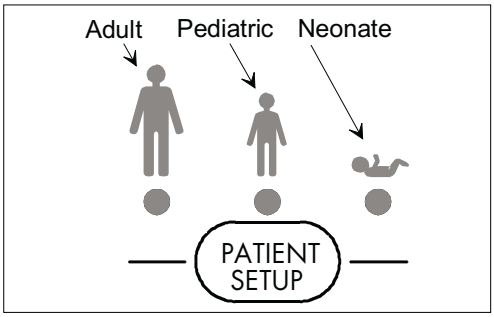


Figure 1-8 - Patient Size Graphics and Indicators

1.3.2.2 Cuff Inflation Pressure

The initial cuff inflation pressure depends on the Patient Size setting. The initial cuff inflation pressures are listed in the table below. The initial cuff inflation pressures can be modified from the default (custom or factory) settings. When the Accutorr Plus is powered down, these modifications are deleted.

1. To change the initial cuff inflation pressure, press and hold the PATIENT SETUP key (37) (2 beep tones, approx. 3 seconds). The current initial cuff pressure for the selected patient size displays in the MAP display.
2. Use the Patient Info. Up and Down Arrow keys (27 & 28) to change the pressure.
3. Once the desired pressure is displayed, press the PATIENT SETUP key (37) to enter this value. **NOTE:** Waiting 15 seconds will also enter this value.

PATIENT SIZE SETTING	INITIAL FACTORY DEFAULT CUFF INFLATION VALUES	LOWEST SELECTABLE PRESSURE	HIGHEST SELECTABLE PRESSURE	INCREMENT
Adult	180 mmHg	100 mmHg	260 mmHg	5 mmHg
Pediatric	140 mmHg	60 mmHg	160 mmHg	5 mmHg
Neonate	100 mmHg	40 mmHg	120 mmHg	5 mmHg

NOTE: The default patient size and initial cuff inflation pressure can be customized. See section 1.3.15, "User Configuration" for details on how to set custom defaults.

1.3.2.3 Room Number and Bed Letter

To monitor more than one patient, assign each patient to a particular room number and bed letter. Use the ROOM/BED key (24) to set the room number from 0 to 99 and the bed letter as a, b, c or d. On initial power up (no stored patient data), the room number and bed letter default to 0,a.

1. Press the ROOM/BED key (24). The ROOM LED flashes indicating that the room number can now be changed.

2. Press the Patient Info. Up or Down Arrow key (27 & 28) to increment or decrement the room number.

3. Press the ROOM/BED key again. The BED LED flashes.

4. Press the Patient Info. Up or Down Arrow key (27 & 28) to increment or decrement the bed letter.

5. Press the ROOM/BED key a third time to exit this mode, or do not press the key for 15 seconds.

Once measurements have been taken, and the unit is powered off and on, the room number and bed letter will default to the lowest room and bed where data is currently stored.

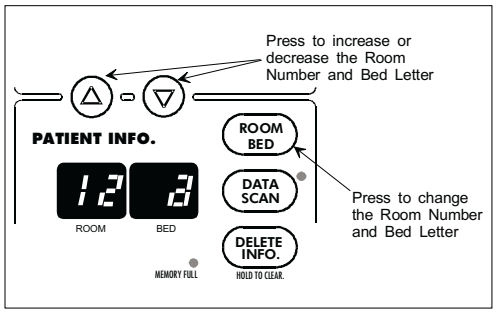


Figure 1-9 - Room Number and Bed Letter Keys and Indicators

1.3.3 MANUAL NIBP MEASUREMENTS AND GENERAL NIBP MEASUREMENT INFORMATION

1. Select a pressure cuff that is appropriate for the size of the patient. Use the chart below as a guideline.

Limb Circumference (cm)	Description / Cuff Name	Datascope Part Number
Disposable Cuffs - Latex Free		
30 - 45	Large Adult	0683-07-0001-01
24 - 36	Adult	0683-07-0001-02
18 - 27	Child	0683-07-0001-03
16 - 25	Small Child	0683-07-0001-04
Disposable Neonatal Cuffs (box of 10)		
Approximate Limb Circumference:		
Size 0: 5 - 8 cm		0683-03-0004-01
Size 1: 7 - 10 cm		0683-03-0001-01
Size 2: 9 - 13 cm		0683-03-0002-01
Size 3: 12 - 17 cm		0683-03-0003-01
Color Coded Cuffs - Reusable Cuffs**		
45 - 66	Thigh - Tan*	0998-00-0003-36
30 - 47	Large Adult - Gray	0998-00-0003-35
24 - 36	Adult - Brown	0998-00-0003-34
18 - 27	Child - Red	0998-00-0003-33
6 - 11	New Born - Blue	0998-00-0003-31
	Infant	0998-00-0003-32

A cuff that is too small for the limb will result in erroneously high readings. The correct size of the pressure cuff for a given patient has, among other considerations, a direct bearing on the accuracy of the obtained NIBP measurements. Base your selection of the cuff size on the limb circumference of the patient. The table above indicates the available Datascope cuffs for use with the Accutorr Plus. The design dimensions of the cuffs and their intended uses are based on recommendations of the American Heart Association.

NOTE: The cuffs that are used with the Accutorr Plus use special snap on connectors. Adapter hoses are available to connect older style cuff connectors. See Optional Accessories, Section 5.2 in the Operating Instructions for a detailed list of cuffs and adapter hoses.

WARNING: *Use only Datascope cuffs. Use of other than Datascope cuffs may result in erroneous measurements.*

The pressure on the limb may not fall to zero between measurements if the cuff is wrapped too tightly. Therefore, assure that the cuff is properly applied.

The skin is sometimes fragile (i.e., on pediatrics, geriatrics, etc.). In these cases, a longer timer interval should be considered to decrease the number of cuff inflations over a period of time. NOTE: In extreme cases, a thin layer of soft roll or webril cotton padding may be applied to the limb in order to cushion the skin when the cuff is inflated. This measure may affect NIBP performance and should be used with caution.

* *When using the thigh cuff, this product may not comply with product specifications listed in chapter 3.*

** *The limb circumferences of the color coded cuffs adhere to the AHA guidelines for size. They also incorporate index and range lines to assist in cuff selection. The cuff bladder and hose contain Natural Latex rubber. The bladder has a dacron cover.*

2. Attach the cuff hose to the NIBP cuff connector (18). To do this, hold the hose behind the knurled pressure fitting (female). Push onto the male connector until a click is heard. To remove, hold the knurled female fitting and pull firmly to release.

3. Apply the cuff to the patient. To reduce errors, the cuff should fit snugly, but with enough room for two fingers to be placed between the cuff and the patient's arm (on adults), and with little or no air present within the cuff. Cuff should fit loosely on neonates. Apply the cuff so that the center of the inflation bag (bladder) is over the brachial artery. Be sure that the INDEX line on the cuff falls between the two RANGE lines. If not, a larger or smaller cuff is required. Be sure the cuff lies directly against the patient's skin. For best results, the cuff should be placed on the arm at heart level and no clothing should come between the patient and the cuff. **NOTE**: Avoid compression or restriction of the pressure hose.
NOTE: The NIBP cuff should not be placed on a limb that is being utilized for any other medical procedure. For example, an I.V. catheter.

4. If required, select the patient size with the PATIENT SETUP key (37). On initial power up, the configurable default setting is used. Otherwise, the last selected patient size is used. Initial default cuff inflation pressures depend on the Patient Size setting. See section 1.3.2.2 for details on changing the initial cuff inflation pressure.

5. Press the START NIBP key (38) to begin an NIBP measurement. A beep is sounded after a completed measurement.

   NOTE: Inflate the cuff only after proper application to the patient's limb. Cuff damage can result if the cuff is left unwrapped and then inflated.

   The cuff begins to inflate to the selected cuff pressure. After reaching the selected pressure, the cuff begins to slowly deflate and the Accutorr Plus collects oscillometric pulsations.

   If the initial cuff inflation is found to be inadequate, the unit retries with a higher inflation pressure (+50 mmHg in the adult mode; +50 in the pediatric mode; +40 mmHg in the neonate mode). A triple beep tone is generated. NOTE: Any time there is an unsuccessful NIBP measurement, a triple beep tone is generated and the Diastolic, Systolic, NIBP HR, MAP and Timer/Temp LED's will be replaced with dashes.

   Have the patient remain still to avoid unnecessary motion artifact. After the cuff pressure drops below the diastolic pressure, the results of the measurement are displayed and the cuff is vented to atmosphere.

   If an error code displays in the Systolic Display or a status code in the Room/Bed Display, refer to Section 1.3.16, Status and Error Codes, for its explanation. A successful measurement clears a status code. To clear a status code, press the ROOM/BED NUMBER key (24).

6. When required, press the DEFLATE key (36) to interrupt a measurement. The cuff will deflate.

NOTE: Once the initial measurement is taken for a room/bed, the Accutorr Plus will continue to use the selected patient size.

NOTE: Check the patient's limb for any indications of circulation impairment.

1.3.3.1 NIBP Pressure Limit Fail Safe

If the cuff is over-pressurized, it will automatically deflate and the status code 8812 *(STOP - CUFF OVERPRESSURE)* or error code 987 *(STOP - HARDWARE OVERPRESSURE)* will be displayed in the Room/Bed or display.

The unit must be turned off and back on again to reset the hardware overpressure switch (error code 987) before any new measurements can be taken.

1.3.3.2 Cuff Inflation Time

If the cuff pressure does not attain 20 mmHg within 40 seconds of the start of inflation or if the target pressure is not reached within another 60 seconds, then the cuff is deflated and status codes will be displayed in the Room/Bed display. See section 1.3.16 for a list of error and status codes.

1.3.3.3 Automatic Adjustment of Cuff Inflation Pressure (Adaptive Inflation)

The unit adjusts the inflation pressure according to the previous reading of the systolic pressure. After the first successful measurement, the inflation pressure is the previous systolic +50 mmHg in the adult mode and +50 mmHg in the pediatric mode and +40 mmHg in the neonate mode. When not in interval mode, the adaptive inflation may be disabled.

To view the current inflation pressure, press and hold (2 beep tones, approximately 3 seconds) the Patient Setup Key (37). The current inflation pressure is shown in the MAP display. If required, use the Patient Info. Up & Down Arrow keys (27 & 28) to change the inflation pressure.

It is also possible to permanently override this adjustment in the User Configuration. See section 1.3.15 for details.

1.3.4 AUTOMATIC NIBP MEASUREMENTS (Interval Mode)

The Accutorr Plus can be set to automatically take NIBP measurements. On initial power up, the interval setting will default to OFF. The User Configuration mode can be used to set custom defaults for the Interval Mode. See section 1.3.15, User Configuration for details. In this mode, the adaptive inflation is always enabled.

Follow Steps 1 - 4 in the Manual Procedure, Section 1.3.3, to select, attach and apply the cuff and to adjust the initial cuff inflation pressure.

5. Press the INTERVAL key (34). The current selection is displayed in the Interval/ Elap.Time/Temp. display (33). Press the INTERVAL key to scroll to the next available interval selection. The selections are: Off (—- when set to graphic display), CONT (continuous), 1, 2.5, 5, 10, 15, 20, 30, 60, 120 and 240 minutes. When an interval setting is selected, except for Off, the Interval Indicator (35) flashes. When the interval mode is activated the Interval Indicator illuminates continuously.

6. The displayed interval time is entered when the INTERVAL key has not been pressed for 15 seconds or,
   when the TIMER/TEMP key (32) is pressed, which changes the display back to Elap. Time or, when the START NIBP key (38) is pressed, which initiates an NIBP measurement, activates the Interval Mode, and changes the display back to Elap. Time.

7. If the START NIBP key (38) has not already been pressed, press to take a measurement and to activate the interval mode. NOTE: If the interval time is changed, the START NIBP key does not need to be pressed for the new interval to initiate. When the new time interval has elapsed, a measurement will be taken.

NOTE: When the NIBP continuous interval is chosen, the Accutorr Plus will take back to back (one right after the other) blood pressure readings. As a safety precaution, a five minute limit is placed on continuous measurements. After 5 minutes, the NIBP interval will automatically switch to measurements taken once every 5 minutes. This is done to reduce the chance of surface vessel rupture (petechia).

If it is desirable to maintain a fixed cuff inflation pressure, the adaptive inflation feature may be disabled in this “continuous” mode.

1.3.4.1 Canceling an Automatic NIBP Measurement

To cancel a scheduled measurement, press the DEFLATE key (36). This will suspend the timed NIBP measurements until the START NIBP key (38) is pressed. The interval indicator will flash. See section 1.3.4.4 for more details on the start and deflate function.

NOTE: Pressing the DEFLATE key (36) will also end a measurement cycle that is already in progress.

To take an immediate measurement and to reactivate the Interval mode, press the START NIBP key (38). The next timed measurement will be taken at the time set by the interval. For example, if the interval was set to 30 minutes, the next timed measurement will be 30 minutes after the START NIBP key was pressed. NOTE: If the Interval mode is no longer required, set the interval to “OFF” prior to pressing the START NIBP key. See section 3.4 for details on changing the interval mode.

NOTE: If the DEFLATE key (36) is pressed, it will take 10 seconds before another measurement can be taken. The START NIBP INDICATOR (39) will be illuminated, when ready.

NOTE: When in the Interval mode and the Room/Bed is changed, the interval mode is suspended (interval indicator flashes) until the NIBP Start key is pressed.

1.3.4.2 Changing the Interval Setting

If the interval time is changed while the Accutorr Plus is in the interval mode, the new interval time is used once it is entered. For example: The interval time is set to 60 minutes. Thirty minutes have elapsed since the last timed automatic measurement and the interval time is changed to 10 minutes. Once the interval time is entered, the Accutorr Plus will take an automatic NIBP measurement in 10 minutes and then once every 10 minutes.

1.3.4.3 Effects of Changing the Room Number and/or Bed Letter on the Interval Setting

When the Room Number and/or Bed Letter is changed, the interval setting will remain the same. **NOTE:** The interval setting can be changed if required. Also, if an NIBP measurement is in progress, the measurement will stop and the cuff will deflate. The timed interval measurements will not activate again (interval indicator flashes) until the START NIBP key (38) is pressed.

1.3.4.4 START and DEFLATE Functions

The START NIBP and DEFLATE functions have the following effects on the timed measurement sequence.

INTERVAL mode is active and the START NIBP key (38) is pressed causing an unscheduled measurement to be taken. Taking this unscheduled measurement does not affect the timing of the interval cycle, therefore, the scheduled measurements will still be taken as if there were no interruptions. Only one measurement is taken for each measurement cycle - even if the unscheduled measurement coincides with the scheduled measurement.

INTERVAL mode is active and the DEFLATE key (36) is pressed. The INTERVAL INDICATOR (35) flashes. No additional measurements will be taken until the START NIBP key (38) is pressed. If a timed measurement is in progress, the measurement is suspended and the cuff deflates.

INTERVAL mode is active and the interval time is changed. The measurement cycle is reset with the new interval. A measurement will be taken after the new interval time has elapsed.

1.3.5 ALARMS

The Accutorr Plus provides "HI" and "LO" alarm limit settings for systolic, diastolic, MAP, pulse rate and SpO_2. An alarm violation occurs when one or more patient parameters equals or falls outside the limits that have been specified.

1.3.5.1 Setting Alarm Limits

The Factory Default for all parameter alarms, except Low SpO_2, is OFF. The Low SpO_2 factory default is 86. The User Configuration mode can be used to set custom defaults. See section 1.3.15, User Configuration for details. The factory and custom defaults for alarms can be changed as required to accommodate the needs of individual patients. The SET ALARMS key (29) and the Patient Info. Up and Down Arrow keys (27 & 28) are used to set alarm values.

1. Press the SET ALARMS key (29) (1 beep) to enter into the alarm set mode.

   The first time this key is pressed, all NIBP displays blank except for the systolic display which shows the current high systolic alarm value. The word HI is displayed in the Interval/Elap. Time/Temp display (33). When the unit has been configured to display graphics, the symbol ⩵⩵ is displayed. When the graphic is displayed, the top lines blink. This indicates the high alarm is selected.

   The second time the SET ALARMS key (29) is pressed the Systolic LO parameter is selected. The word LO is displayed in the Interval/Elap. Time/Temp display (33). When the unit has been configured to display graphics, the symbol ⩵⩵ is displayed. When the graphic is displayed, the bottom lines blink. This indicates the low alarm is selected.
   Each time the SET ALARMS key (29) is pressed a new parameter is selected for alarm setting (all other displays blank). The order they are available is: Systolic HI, Systolic LO, Diastolic HI, Diastolic LO, MAP HI, MAP LO, Pulse Rate HI, and Pulse Rate LO, SpO_2 HI and SpO_2 LO. When all of the available parameters have been selected, the next press of the SET ALARMS key returns the Accutorr Plus to normal operation.

2. To change an alarm limit setting, use the Patient Info. Up & Down Arrow keys (27 & 28). The Up arrow increments the alarm limit setting. The Down arrow decrements the alarm limit setting.

   To cancel all of the changed alarm values while still in progress of changing, press the DEFAULTS key (14) (1 beep tone).

   If the SET ALARMS or Arrow keys have not been pressed for 15 seconds, the Accutorr Plus returns to normal operation and saves any alarm limit changes.

   NOTE: If the patient size is changed, the alarm settings will change to the default settings for the new patient size.

Alarm Limit Table

PARAMETER	RANGE	UNITS	FACTORY DEFAULT	UNITS OF INCREMENT
Systolic High				
Adult	Off, 60-260			
Pediatric	Off, 60-160	mmHg	Off	5
Neonate	Off, 50-125			
Systolic Low				
Adult	Off, 55-150			
Pediatric	Off, 55-130	mmHg	Off	5
Neonate	Off, 45-115			
Diastolic High				
Adult	Off, 40-200			
Pediatric	Off, 40-150	mmHg	Off	5
Neonate	Off, 35-100			
Diastolic Low				
Adult	Off, 30-120			
Pediatric	Off, 30-50	mmHg	Off	5
Neonate	Off, 25-50			
MAP High				
Adult	Off, 90-200			
Pediatric	Off, 90-150	mmHg	Off	5
Neonate	Off, 60-110			
MAP Low				
Adult	Off, 40-100			
Pediatric	Off, 40-70	mmHg	Off	5
Neonate	Off, 30-70			
Pulse Rate High				
Adult	Off, 100-245			
Pediatric	Off, 100-245	bpm	Off	5
Neonate	Off, 100-245			
Pulse Rate Low				
Adult	Off, 35-120			
Pediatric	Off, 35-150	bpm	Off	5
Neonate	Off, 75-200			
SpO2 High				
Adult	Off, 61-99			
Pediatric	Off, 61-99	%SpO2	Off	1
Neonate	Off,61-99			
SpO2 Low				
Adult	60-95			
Pediatric	60-95	%SpO2	86	1
Neonate	60-95			

1.3.5.2 Alarm Violations

An alarm condition exists if the parameter is equal to or is outside the high/low limit range that has been set. When an alarm limit is violated, the following actions occur:

The LEDs for the parameter in an alarm condition flashes.

The parameter in an alarm condition is in reverse video on the LCD (Accutorr Plus models with Trend Screen).

The alarm tone is sounded (unless muted with the MUTE key (30)).

The parameter(s) that was in an alarm condition will be in brackets [ ] when printed on the recorder.

1.3.5.3 How to Mute Alarms

When an NIBP alarm exists, press the MUTE key (30) (1 beep tone) to silence the alarm tone for 2 minutes. The alarm tone will return after the next measurement value that violates the selected limits.

When an SpO_2 alarm exists, press the MUTE key (30) (1 beep tone) to silence the alarm tone for two minutes. The alarm tone will return after two minutes, unless the SpO_2 value changes and is within the alarm limits. If during that two minutes the measured SpO_2 value changes to a value that is within the acceptable range, and then returns to a value that is outside the set alarm limit, the alarm tone will return before the two minutes elapse. Example (within 2 minutes): • SpO_2 low alarm limit has been set to 90. • SpO_2 is measured at 89; the alarm tone sounds and the SpO_2 display flashes. • The MUTE key is pressed. • SpO_2 is measured at 88; there is no alarm tone, but the SpO_2 display flashes. • SpO_2 is measured at 91; no alarm tone sounds and the display stops flashing. • SpO_2 is measured at 89; the alarm tone sounds and the SpO_2 display flashes.

Press and hold the MUTE key (30) (2 beep tones, approx. 3 seconds) to permanently silence the alarm tone. The MUTE LED (31) illuminated. The LEDs for the alarming parameter will continue to flash. To reactivate the alarm tone function, press the MUTE key (30) again.

1.3.5.4 Alarms and Changing the Room Number and/or Bed Letter

When changing the rooms and beds, the alarm settings will change if the final room/bed displayed is a different patient size than the original room/bed. When a new patient size is detected, the alarm settings change to the defaults for the different patient size. See section 1.3.15 for information on custom defaults.

The table below describes 6 measurements in different rooms/beds and different patient sizes, and the effect on the alarm settings.

Measurement Order	Room/Bed	Patient Size	Alarm Settings
1	1/a	Adult	Have been manually set.
2	1/b	Adult	Remain the same.
3	2/a	Pediatric	Changed to defaults for a pediatric size patient.
4	3/a	Adult	Changed to defaults for an adult size patient.
5	4/a	Adult	Remain the same.
6	1/a	Adult	Remain the same. If the alarm settings that were set from the 1st measurement are required, they need to be set again manually.

NOTE: The alarm settings can be changed, if necessary, when changing the room/bed and the patient size is the same.

PRECAUTION: It is the users responsibility, when changing the room/bed, to assure the patient size and alarm settings are as required.

1.3.6 TO VIEW AND DELETE STORED DATA (Trend Mode)

All models of the Accutorr Plus are capable of storing up to 100 entries of measurement data. Each time a successful NIBP measurement is made, the data is automatically stored in memory. When a temperature measurement is made between two minutes before and two minutes after an NIBP measurement, it is stored as the same entry with the NIBP measurement. If a temperature measurement is made outside this time, it is stored as a separate entry. When either NIBP or temperature measurements are stored and SpO_2 information is available, then the SpO_2 data is also stored.

When 80 entries are stored into trend memory, the MEMORY FULL Indicator (20) will flash. When 100 entries are stored into trend memory, the MEMORY FULL Indicator (20) will illuminate continuously. Once 100 entries are stored, old data can be deleted manually for any patient; or when new data is available, the Accutorr Plus will automatically delete the oldest data for the currently displayed patient.
NOTE: The unit will also automatically delete data that is 24 hours old.

The Accutorr Plus NIBP uses the Systolic, Diastolic, MAP, and Temp displays to view stored data. The Accutorr Plus models with Trend Screen use the LCD to display up to 5 measurements at a time. The stored data that is viewed is for the currently selected patient (indicated by the room number/bed letter).

1.3.6.1 To View the Stored Measurements on the Accutorr Plus NIBP

1. Press the DATA SCAN key (22) (1 beep tone). The DATA SCAN Indicator (23) illuminates.

2. Press the Patient Info. Up and Down Arrow keys (27 & 28) to view stored data for the current patient. The stored data is displayed in the Systolic, Diastolic, MAP, Pulse Rate and Temp displays.

   Consecutive presses or pressing and holding the UP or DOWN arrow will allow the stored measurements to continuously wrap around. When the measurements wrap, a double beep tone will sound. If a temperature measurement is not available for the NIBP measurement that is displayed, then - - - - is shown in the Interval/Elap. Time/Temp display (33). To view the time of measurements, press the TIME/TEMP key (32).

3. To exit the view stored data mode, press the DATA SCAN key (22) (1 beep).

1.3.6.2 To View the Stored Measurements on the Accutorr Plus NIBP with Trend Screen and the Accutorr Plus NIBP with Trend Screen and SpO_2

The stored measurements on the Accutorr Plus models with Trend Screen are displayed in the LCD. Up to 5 stored measurements are displayed at one time. Measurements are displayed in time order, with the newest measurement at the top. A scroll bar with one or both arrows will display on the side of the LCD when more measurements are available to view. When only one arrow displays, more measurements are only available in the direction of the arrow.

1. To view more measurements press the LCD Up or Down Arrow key (9 & 10).

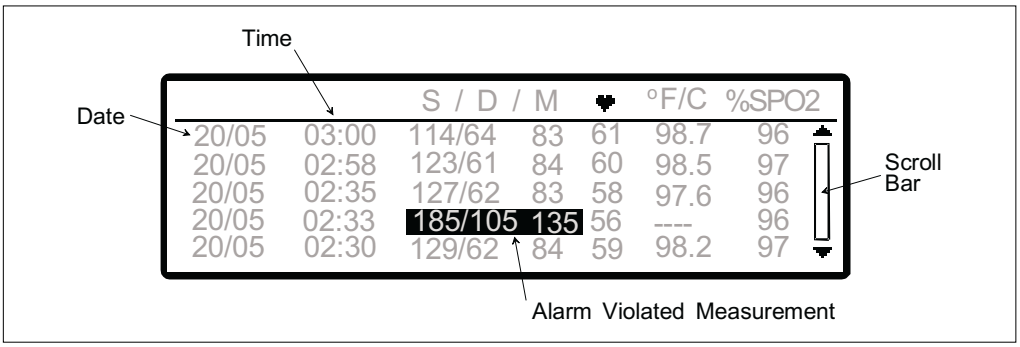


Figure 1-10 - LCD Trend List Display

1.3.6.3 To Delete the Stored Measurements on all Models of the Accutorr Plus

While viewing stored data, you can delete the most recent measurement or all of the stored measurements for the currently displayed patient.

1. Select a room/bed where stored information can be deleted. (See section 1.3.2.3 for details on selecting a room/bed.) If it is the currently displayed room/bed, go to step 2. When you are uncertain what rooms/beds have stored data, press and hold the DATA SCAN key (22) (2 beep tones, more than 3 seconds). The Accutorr Plus will scan through all of the rooms/beds that have data stored. To stop on a Room/Bed as the Accutorr Plus is scanning, press the DATA SCAN key (22). **NOTE:** The Accutorr Plus will scan through the rooms/bed with stored data only once.

2. On the Accutorr Plus NIBP only, when the desired room/bed is displayed, press the DATA SCAN key (22) (1 beep tone). The DATA SCAN Indicator (23) illuminates.

3. When the most recent stored data is displayed, press and hold the DELETE INFO. key (21) (1 beep tone, approx. 3 seconds) to delete this measurement.

4. When viewing any of the stored measurements, press and hold the DELETE INFO. key (21) (2 beep tones, approx. 6 seconds) to delete all stored measurements for the current patient. When all data is cleared the patient size will be the default selection.

5. On the Accutorr Plus NIBP only, press the DATA SCAN key (22) (1 beep tone) to exit the delete data mode.

NOTE: The unit will also automatically delete data that is 24 hours old.

NOTE: To delete all information for all patients, press and hold the DELETE INFO. key (21) while powering on the unit.

1.3.7 SETTING THE ALARM VOLUME AND BEEP VOLUME

The LCD on the Accutorr Plus models with Trend Screen is used to display the Trend List as described in section 1.3.6. It is also used to display a menu which is used to set the alarm volume and the SpO_2 beep volume. The MENU key (8), the LCD Up and Down Arrow keys (9 & 10), and the SELECT key (12) are used to set these volumes. The User Configuration mode can be used to set custom defaults for the alarm volume and beep volume. See section 1.3.15, User Configuration for details.

1. Press the MENU key (8) to display the menu. The menu is shown in figure 3-4. The alarm volume is initially highlighted when the menu is displayed. The highlighting indicates this item can be changed.

2. Press the LCD Up and Down Arrow keys (9 & 10) to change the current selection for the alarm volume. The selections are: OFF, 1, 2, 3, 4, and 5 with 5 being the loudest.

3. Press the SELECT key (11) to move the highlighting to SpO_2 beep volume.

4. Press the LCD Up and Down Arrow keys (9 & 10) to change the current selection for the SpO_2 volume. The selections are: OFF, 1, 2, 3, 4, and 5 with 5 being the loudest.

5. Press the MENU key (8) again to exit the menu and return to the Trend screen.

NOTE: Any changes made to the alarm volume or the SpO_2 volume will be erased when the unit is turned off and then back on again. Also, any changes made (except off) will restore and enable the alarm tone, regardless of prior mute condition.

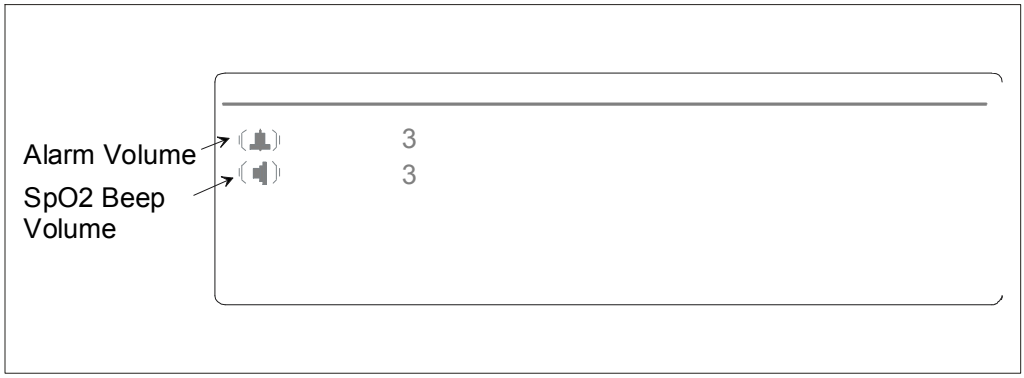


Figure 1-11 Menu

1.3.8 SETTING THE LCD CONTRAST (View Angle Adjustment)

The LCD on the Accutorr Plus models with Trend Screen can be adjusted for optimum viewing. The MENU key (8) and the LCD Up and Down Arrow keys (9 & 10) are used to adjust the contrast.

1. Press and hold the MENU key (8) (2 beep tones, approx. 3 seconds). A beep tone is generated when the key is first pressed and the display changes to the menu. When a second beep tone is generated, release the key.

2. To quickly adjust the contrast, press and hold either the LCD Up or Down Arrow key (9 or 10). For fine adjustment, momentarily press either the LCD Up or Down Arrow key.

3. The LCD contrast adjustment is saved by either pressing the MENU key (8) again or not pressing either the LCD UP or Down Arrow keys (9 & 10) for 15 seconds.

NOTE: The contrast setting will be the same each time the unit is turned on, unless readjusted by the user.

1.3.9 DISPLAY TIME OUT MODE

To conserve power, most displays will blank at user selected times. The LCD illumination time out can be set between 3 and 15 minutes. The LED display time out can be set between 5 and 60 minutes. Since the Accutorr Plus can be powered from either an AC or DC source, the user configuration allows the setting of separate times for each type of power source. See User Configuration, section 1.3.15 for more information on setting the time out minutes.

To turn on the LCD light, press the MENU key (8). To turn on the LED displays, press any key.

1.3.10 SpO_2 MEASUREMENTS (Accutorr Plus model with SpO_2)

To obtain SpO_2 measurements and SpO_2 Heart Rate from the Accutorr Plus model with SpO_2: See Section 3.10.1 for units with Datascope SpO_2; for units with Nellcor SpO_2 see section 3.10.2; for units with Masimo SpO_2 see section 1.3.10.3)

CAUTION: *Do not place the sensor on an extremity with an invasive catheter or blood pressure cuff in place.*

CAUTION: *A pulse oximeter should not be used as an apeana mnitor.*

CAUTION: *A pulse oximeter should be considered an early warning device. As a trend towards patient deoxygenation is indicated, blood samples should be analyzed by a laboratory co-oximeter to completely understand the patient's condition.*

CAUTION: *Ensure proper routing of the patient cable to avoid entanglement and/or strangulation*

NOTE: In the event you are unable to obtain a reading, or the reading is inaccurate, check the patients vital signs by alternate means and consider the following:

If your patient is poorly perfused, try applying the sensor to another site (i.e. A different finger or toe).

Check that the sensor is properly aligned.

In electrosurgery, make sure the sensor is not too close to ESU devices or cables.

Check to make sure the site area is clean / non-greasy. Clean the site and sensor if needed. Nail polish and fungus should be removed.

1.3.10.1 Datascope Pulse Oximetry Sensors

A. Introduction

A wide range of Datascope sensors are available for connection to the Accutorr Plus model with SpO_2. The sensors cover both short-term and long-term monitoring needs on patients ranging from infants to large adults.

The DATASENSOR is intended for short-term adult monitoring.

The FLEXISENSOR® SD, available in five different sizes, provides both short-term and long-term monitoring for large adults, adult ear, adults, pediatrics, and infants. The FLEXISENSOR® SD is used when the DATASENSOR is not convenient or suitable.

The ear sensor is intended for long-term adult monitoring. A range of disposable bandages are available for use with the FLEXISENSOR® SDs. They are available in 2styles, SENSOR GUARD™ (used for large adults, adults and pediatrics), and Coban with SENSOR GUARD™ (used for infants).

Use of the sensors does not cause any penetration of the skin, nor is there any electrical contact or transfer of excessive heat to the patient.

The sensor is composed of a dual light emitting diode (LED) (emitter) and a photo diode (detector). The emitter discharges two colors (wave lengths) of light into the patient's extremity (finger, toe, ear). The detector receives the light not absorbed by the blood or tissue components. The Accutorr Plus model with SpO_2 then uses the

relative absorption of the two light wavelengths to compute and display SpO_2 (functional saturation) and Pulse Rate measurements.

The key benefits of the sensors are:

Electro-Surgical Noise (ESU) Rejection - The sensor configuration of both the DATASENSOR and the FLEXISENSOR® SD provide uninterrupted monitoring and absence of false alarms during the use of ESU (ESU can be set at any power level). This design prevents electro-surgical noise entering the monitor, via the sensor, and interfering with unit operation.

Monitoring Restless Patients - Motion artifact rejection is achieved in several ways.

1. The sensor design used with their recommended bandages assures a snug fit of the sensor to the patient.
2. Light emitting diodes (LEDs) and detectors gather a strong signal from the patient.
3. When in the presence of motion, the software adjusts the "averaging-period", increasing it to a maximum of 15 seconds during motion, and automatically reducing it during quiet periods to obtain a fast response. This combination reduces the number of monitoring interruptions and false alarms from patient motion.

Tracking of Weak Peripheral Pulse Levels - Many patients suffer poor peripheral perfusion due to hypothermia, hypovolemia, reduced cardiac output, etc. The Accutorr Plus model with SpO_2 is designed to automatically increase its gain to track patients with poor peripheral perfusion.

Rejection of Ambient Light - Many monitoring situations involve high levels of ambient light, i.e.., operating room lights, neonatal phototherapy, heat warmers, etc. The Accutorr Plus model with SpO_2, the sensors, and the bandages each contribute to the rejection of ambient light. The monitor automatically measures and corrects for high levels of ambient light. The enclosed design of the DATASENSOR prohibits the interference of high levels of ambient light on adults with sensor operation. The opaque material used in the composition of the bandages, which are used with the FLEXISENSOR® SD, helps keep out ambient light.

Patient Comfort - The FLEXISENSOR® SD line is designed to work with a disposable bandage of two styles (SENSOR GUARD TM and Coban) which conform comfortably and safely to the particular patient's anatomy.

B. Sensor Selection and Application

Selection of a specific sensor is based on the patient's size, physical condition, and expected monitoring duration. General guidelines for the selection of a sensor are provided in the Sensor Selection Table, page 3-25. Instructions for the application of a sensor to a patient are provided in each sensor package. For optimal DATASENSOR and FLEXISENSOR® placement ensure that cable side is placed in the correct position. See figures below.

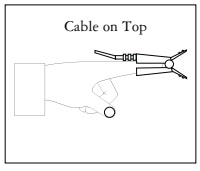


Figure 1-12 Datasensor or Durasensor Placement

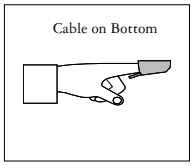


Figure 1-13 Flexisensor^P Placement

C. Sensor Connection to the Accutorr Plus model with SpO_2

1. Align the cable connector on the sensor assembly with the SpO_2 Connector (15) on the Accutorr Plus model with SpO_2.

2. Push the cable connector into the SpO_2 Connector (15). Confirm that the cable connector is securely in place.

3. The digital SpO_2 values and SpO_2 pulse rate will be displayed in the SpO_2 and pulse Rate LED's.

4. If desired, adjust the beep volume. See section 3.7, Setting the Alarm Volume and Beep Volume, for details on adjusting the beep volume.

D. Sensor Inspection

Before use, always inspect sensors, cables, and connectors for damage, i.e., cuts and abrasions. Do not use the sensor, cable or connector if damaged. Replace with a good working sensor.

For long sensor life:

Do not drop on the floor, or give other sharp shocks to the sensor(s). Between use, store the sensors in the accessory pouch, or coil the sensor cable and store on the side of the Accutorr Plus rolling stand using the optional cable retainer. For accessory part number information see Section 5.2, "Optional Accessories".

Avoid running any cart, bed, or any piece of equipment over the sensor cable.

Avoid strong pulls on the sensor cable (10 lbs/4kg).

Watch for cracks in the DATASENSOR housing.

Watch for cracks, cuts, rips, fogging, or signs of moisture in the FLEXISENSOR® SD

E. Sensor Performance

For the BEST performance:

DO NOT PLACE any sensor on an extremity with an arterial catheter or blood pressure cuff in place. Placement of an arterial catheter or blood pressure cuff on an extremity may obstruct normal blood flow. False pulse rate information may result if the FLEXISENSOR® SD is placed on that same extremity. Place the sensor on the limb opposite the site of the arterial catheter or blood pressure cuff.

Encourage the patient to remain still. Patient motion may affect the sensor's performance. If it is not possible for the patient to remain still, replace the sensor bandage on the FLEXISENSOR® SD to assure good adhesion, or change the site of the DATASENSOR.

Check the DATASENSOR site every 2 hours and check the FLEXISENSOR® SD site every 8 hours for indications of skin abrasions, sensor displacement, sensor damage, or circulation impairment. Check the sensor site every 4 hours if the ear clip is used. If necessary, remove and reapply the sensor. If any of the above mentioned indications occur, immediately remove the sensor and find an alternate site. NOTE: Check the sensor site more frequently on infant and active patients.

Incorrect placement can also reduce the acquired sensor signal, and therefore compromise performance. Select an alternate site (toe) or use a FLEXISENSOR® SD if the sensor can not be placed on the patient's finger correctly or if the fingernails interfere with the acquisition of a reliable signal.

Use of the DATASENSOR is not recommended for long-term monitoring (4-6 hours). For monitoring situations exceeding 4-6 hours, either reposition the DATASENSOR every 2-4 hours to a different site (finger/toe) or use a FLEXISENSOR® SD with its appropriate bandage.

Do not over-tighten the sensor bandages. Excessive pressure on the monitoring site can affect SpO_2 readings and may reduce readings below true SpO_2. Excessive pressure can also result in pressure necrosis and other skin damage.

Sensor configuration provides virtually uninterrupted monitoring during following situations:

Electro-cautery Noise - Electro-cautery noise rejection is designed into the sensors.

Motion Artifact - The monitor's software adjusts the "averaging period" increasing it during motion and reducing it during inactivity. This decreases the number of monitoring interruptions and false alarms.

Weak Peripheral Pulses - The monitor's gain is automatically increased to track pulses on patients with decreased peripheral perfusion.

Datascope SpO_2 Sensor Selection Table

Sensors		Large Adult (LA)	Adult (A)	Pediatric (P)	Infant (I)	Adult Ear (AE)	Datasensor
Approximate Patient Weight		>80kg/ >176 lbs	0 - 90kg/ 66 - 198 lbs	10 - 40kg/ 22 - 88 lbs	4.5 - 10kg/ 10 - 22 lbs	>40kg/ >88 lbs	40+ kg/ 90+ lbs
Where Used		Fingers, Toes	Fingers, Toes	Fingers, Toes	Feet, Palms, Big Toes	Adult Ear	Fingers, Toes
Long or Short Term Monitoring		Long & Short Term	Long & Short Term	Long & Short Term	Long & Short Term	Long & Short Term	Short Term
Electro-Surgical Interference Suppression (ESIS)		Included	Included	Included	Included	Included	Included
Reusable		Yes Up to 20 Uses	Yes Up to 20 Uses	Yes Up to 20 Uses	Yes Up to 20 Uses	Yes Up to 20 Uses	Yes 6-Months
Bandage Type		Adhesive, Disposable	Adhesive, Disposable	Adhesive, Disposable	Non-Adhesive*	Adhesive	Disposable
Part #'s**	Sensors	0998-00-0076-06	0998-00-0076-05	0998-00-0076-04	0998-00-0074-03	0998-00-0074-05	0600-00-0026-01 (3' sensor cable)***
	Bandages	0683-00-0409-01	0683-00-0409-02	0683-00-0409-03	0683-00-0415	N/A	N/A

* *<Non-adhesive bandages are recommended for premature infants to minimize prenatal skin damage.*

** *See Accessories, Chapter 5, for more detailed information.*

*** *Additional choices: 0060-00-0026-02 (10' sensor cable), 0020-00-0071-01 (3' sensor cable plus 7' extension cable).*

1.3.10.2 Sequence for establishing SpO_2 with Nellcor® Pulse Oximetry*

** This feature applicable only if available or installed on your unit.*

1.Select the appropriate sensor for the patient from Page 3-28

2. Plug the sensor directly into the SpO_2 connector (15) or if necessary, use a Nellcor SC10 extension cable. **NOTE:** Do not place the sensor on an extremity with an invasive catheter or blood pressure cuff in place.

CAUTION: *When equipped with Nellcor SpO_2, use only Nellcor oxygen transducers including Nellcor Oxisensor patient dedicated adhesive sensors. Use of other oxygen transducers may cause improper oximeter performance.*

CAUTION: *Tissue damage or inaccurate measurements may be caused by incorrect sensor application or use, such as wrapping it too tightly, applying supplemental tape, failing to inspect the sensor site periodically, or failing to position it appropriately. Carefully read the sensor directions for use, the Accutorr Plus operating instructions, and all precautionary information before use.*

CAUTION: *Excessive ambient light may cause inaccurate measurements. Cover the sensor with opaque materials.*

CAUTION: *Inaccurate readings may be caused by incorrect sensor application or use; significant levels of dysfunctional hemoglobins, (i.e. carbohemoglobins or methemoglobin); or intra-vascular dyes such as indocyanine green methylene blue; exposure to excessive illumination, such as surgical lamps (especially ones with a Xenon light source), bilirubin lamps, florescent lights, infrared heating lamps, or direct sunlight; excessive patient movement; venous pulsations; electro-surgical interference; and placement of a sensor on an extremity that has a blood pressure cuff, arterial catheter, or intra-vascular line.*

CAUTION: *In certain situations in which perfusion and signal strength are low, such as in patients with thick or pigmented skin, inaccurately low SpO_2 readings will result. Verification of oxygenation should be made, especially in preterm infants and patients with chronic lung disease, before instituting any therapy or interventation.*

CAUTION: *If the sensor or patient cable is damaged in any way, discontinue use immediately. To prevent damage do not soak or immerse the sensor in any liquid solution. DO NOT ATTEMPT TO STERILIZE.*

3. The digital SpO_2 value and SpO_2 Pulse Rate will be displayed on the SpO_2 and Pulse Rate LED's.

4. If desired, adjust the beep volume. See Section 3.7, "Setting the Alarm Volume and Beep Volume", for details on adjusting the beep volume.

1.3.10.2.1 NELLCOR® Sensors

NELLCOR® provides a family of sensors suitable for a wide variety of clinical settings and patients. Specific sensors have been developed for neonates, infants, children, and adults. OXISENSOR™ oxygen transducers are sterile adhesive sensors with optical components mounted on adhesive tape. OXIBAND® oxygen transducers and the DURAFORM™ oxygen transducer system are reusable sensors that are applied with disposable adhesive. The DURASENSOR® DS-100A adult digit oxygen transducer is a reusable sensor with its optical components mounted in a plastic casing. The NELLCOR® RS-10 reflectance oxygen transducer is an adhesive sensor for application to forehead or temple.

NOTE: NELLCOR®, OXIBAND® **and** DURASENSOR® **are registered trademarks of** NELLCOR® **Incorporated.** OXISENSOR™ and DURAFORM™ are trademarks of NELLCOR Incorporated.

A. Selecting a Sensor

Sensors are designed for specific sites on patients with designated weight ranges. To select the appropriate sensor, consider the patient's weight, level of activity, adequacy of perfusion, which sensor sites are available, whether sterility is required, and the anticipated duration of monitoring.

B. Cleaning and Re-Use

Do not immerse any OXISENSOR™, DURASENSOR®, OXIBAND®, or DURAFORM™ oxygen transducer, the NELLCOR® RS-10 oxygen transducer, or any NELLCOR® adhesive in water or cleaning solution. Clean DURASENSOR®, OXIBAND®, and DURAFORM™ oxygen transducers, and the NELLCOR® RS-10 oxygen transducer by wiping with a disinfectant such as 70% alcohol. Do not sterilize by irradiation, steam, or ethylene oxide. Use a new OXIBAND® adhesive wrap or FORM-A adhesive bandage for each patient. Do not re-sterilize OXISENSOR™ oxygen transducers.

C. Performance Considerations

To insure optimal performance, use an appropriate sensor, apply it as directed, and observe all warnings and cautions.

If excessive ambient light is present, cover the sensor site with opaque material. Failure to do so may result in inaccurate measurements. Light sources that can affect performance include surgical lights, especially those with a xenon light source, bilirubin lamps, fluorescent lights, infrared heating lamps, and direct sunlight. If poor perfusion affects instrument performance, and the patient weighs more than 50 kg (110 lbs.), consider using the OXISENSOR™ R-15 adult nasal oxygen transducer. Because the R-15 obtains its measurements from the nasal septal anterior ethmoid artery, an artery supplied by the internal carotid, this sensor may obtain measurements when peripheral perfusion is relatively poor. For low peripheral perfusion, consider using the NELLCOR® RS-10 reflectance oxygen transducer, which is applied to the forehead or temple.

If patient movement presents a problem:

Verify that the sensor is properly and securely applied.

Use a new sensor with fresh adhesive backing.

Move the sensor to a less active site.

Use a type of sensor that tolerates some patient motion, such as the OXISENSOR™ D-25, D-20, N-25, or I20 oxygen transducer.

NELLCOR® SENSOR FAMILY						
SELECTION GUIDE	**D25/D25L Adult**	**R-15 Adult**	**N-25 Neonatal**	**I-20 Infant**	**D-20 Pediatric**	**RS-10 Adult**
Patient Size	>30 kg	>50 kg	<3 kg >40 kg	1-20 kg	10-50 kg	>40 kg
Duration of Use	Short or Long Term	Short or Long Term	Short or Long Term	Short or Long Term	Short or Long Term	Short Term
Sterility	Sterile[1]	Sterile[1]	Sterile[1]	Sterile[1]	Sterile[1]	Non-sterile
Patient Activity	Limited Activity	Inactive	Limited Activity	Limited Activity	Limited Activity	Limited Activity
	OXISENSOR adult digit oxygen transducer	OXISENSOR adult nasal oxygen transducer	OXISENSOR neonatal oxygen transducer	OXISENSOR infant digit oxygen transducer	OXISENSOR pediatric digit oxygen transducer	RS-10 reflectance oxygen transducer

[1] *In an unopened, undamaged package.*

All NELLCOR® accessories and sensors must be purchased form NELLCOR® Inc., 25495 Whitehall Street, Hayward, Ca. 94545. To contact NELLCOR®, call 1-800-NELLCOR.

D. Automatic Calibration of NELLCOR® Sensors

The oximetry subsystem incorporates automatic calibration mechanisms. It is automatically calibrated each time it is turned on, at periodic intervals thereafter, and whenever a new sensor is connected. Also, the intensity of the sensor's LEDs is adjusted automatically to compensate for differences in tissue thickness.

Each sensor is calibrated when manufactured; the effective mean wavelength of the red LED is determined and encoded into a calibration resistor in the sensor plug. The instrument's software reads this calibration resistor to determine the appropriate calibration coefficients for the measurements obtained by that sensor.

1.3.10.3 Sequence for establishing SpO_2 with Masimo Set® Pulse Oximetry*

** This feature applicable only if available or installed on your unit.*

1. Select the appropriate sensor for the patient from the table below. All sensors below are non-sterile and can be used during patient movement.

MASIMO® SENSOR FAMILY			
SELECTION	**PART NUMBER**	**PATIENT SIZE**	**DISPOSABLE/ REUSABLE**
LNOP®•Adt Adult Disposable Finger Sensor	0600-00-0043-01	> 30 kg.	Disposable
LNOP®•Pdt Pediatric/ Slender Digit Disposable Sensor	0600-00-0044-01	10 to 50 kg.	Disposable
LNOP®•Neo Neonatal Disposable Sensor	0600-00-0045-01	< 10 kg.	Disposable
LNOP®•NeoPt Neonatal Pre-term Disposable Sensor	0600-00-0046-01	< 1 kg.	Disposable
LNOP®•DCI Adult Reusable Finger Sensor	0600-00-0047	> 30 kg.	Re-usable
PC12 Patient Cable Extension	0012-00-1099-02	All	Re-usable

2. Attach the PC12 Patient Cable (P/N 0012-00-1099-02) to the sensor and plug the other end of the patient cable into the SpO_2 connector (15)

NOTE: Do not place the sensor on an extremity with an invasive catheter or blood pressure cuff in place.

NOTE: Ensure proper routing of patient cable to avoid entanglement and/or strangulation.

CAUTION: *When equipped with MASIMO® SpO_2, use only MASIMO® oxygen transducers including MASIMO LNOP® patient dedicated adhesive sensors and MASIMO PC12® Patient Cable. Use of other oxygen transducers may cause improper oximeter performance.*

CAUTION: *Tissue damage or inaccurate measurements may be caused by incorrect sensor application or use, such as wrapping it too tightly, applying supplemental tape, failing to inspect the sensor site periodically, or failing to position it appropriately. Carefully read the sensor directions for use, the Accutorr Plus operating instructions, and all precautionary information before use.*

CAUTION: *Excessive ambient light may cause inaccurate measurements. Cover the sensor site with opaque material.*

CAUTION: *Inaccurate measurements may be caused by incorrect sensor application or use; significant levels of dysfunctional hemoglobins, (e.g., carboxyhemoglobin or methemoglobin); or intra-vascular dyes such as indocyanine green methylene blue; exposure to excessive illumination, such as surgical lamps (especially ones with a xenon light source), bilirubin lamps, fluorescent lights, infrared heating lamps, or direct sunlight; excessive patient movement; venous pulsations; electro-surgical*

interference; and placement of a sensor on an extremity that has a blood pressure cuff, arterial catheter, or intra-vascular line.

CAUTION: *In certain situations in which perfusion and signal strength are low, such as in patients with thick or pigmented skin, inaccurately low SpO_2 readings will result. Verification of oxygenation should be made, especially in preterm infants and patients with chronic lung disease, before instituting any therapy or intervention.*

CAUTION: *Many patients suffer from poor peripheral perfusion due to hypothermia, hypovolemia, severe vasoconstriction, reduced cardiac output, etc. These symptoms may cause a loss in vital sign readings.*

CAUTION: *The site should be checked at least every eight (8) hours (every four (4) hours with the Adult re-usable finger sensor). Ensure proper adhesion, skin integrity, and proper alignment. Nail polish and fungus may effect readings. Exercise extreme caution with poorly perfused patients. Skin erosion and pressure necrosis can be caused when sensors are not frequently monitored. Assess the site every two (2) hours with poorly perfused patients.*

CAUTION: *If the sensor or patient cable is damaged in any way, discontinue use immediately. To prevent damage do not soak or immerse the sensor in any liquid solution. Do not attempt to sterilize.*

3. The digital SpO_2 value and SpO_2 Pulse Rate will be displayed on the SpO_2 and Pulse Rate LED's.

4. If desired, adjust the beep volume. See Section 3.7, "Setting the Alarm Volume and Beep Volume", for details on adjusting the beep volume.

1.3.10.3.1 MASIMO® Sensors and Patient Cable

MASIMO® provides a family of sensors suitable for a wide variety of clinical settings and patients. Specific sensors have been developed for neonates, infants, children, and adults. All sensors are indicated for continuous non invasive monitoring of arterial oxygen saturation (SpO_2) and pulse rate. The LNOP®•DCI Adult Re-usable Finger Sensor can also be used for "spot check" applications if needed. All sensors are intended for "single-patient use only" except for the LNOP®•DCI Adult "Re-usable" Finger Sensor.

A. Selecting a Sensor

Sensors are designed for specific sites on patients with designated weight ranges. To select the appropriate sensor, consider the patient's weight, level of activity, adequacy of perfusion, which sensor sites are available and the anticipated duration of monitoring.

B. Cleaning and Re-use

The sensor may be reattached to the same patient if the emitter and detector windows are clear and the adhesive still adheres to the skin. The adhesive can be partially rejuvenated by wiping with an alcohol wipe and allowing the sensor to thoroughly air dry prior to replacement on the patient.

C. Performance Considerations

To insure optimal performance, use an appropriate sensor, apply it as directed, and observe all warnings and cautions.

If excessive ambient light is present, cover the sensor site with opaque material. Failure to do so may result in inaccurate measurements. Light sources that can affect performance include surgical lights, especially those with a xenon light source, bilirubin lamps, fluorescent lights, infrared heating lamps, and direct sunlight.

Special Features

D. Automatic Calibration

The oximetry subsystem incorporates automatic calibration mechanisms. It is automatically calibrated each time it is turned on, at periodic intervals thereafter, and whenever a new sensor is connected. Also, the intensity of the sensor's LEDs is adjusted automatically to compensate for differences in tissue thickness.

Each sensor is calibrated when manufactured; the effective mean wavelength of the red LED is determined and encoded into a calibration resistor in the sensor plug. The instrument's software reads this calibration resistor to determine the appropriate calibration coefficients for the measurements obtained by that sensor.

E. Oximetry Sensitivity Mode and Post Averaging Time

The Accutorr Plus sensitivity mode for SpO_2 is set to normal and the averaging of the saturation, pulse rate, and signal strength measurements for SpO_2 is set to 8 seconds

1.3.11 TEMPERATURE MEASUREMENT (optional)

NOTE: For information on the optional AccuTemp IR Thermometer Module see the Operating Instructions manual that is provided with the thermometer, part number 0070-00-0346.

NOTE: For information on the Welch Allyn Sure Temp Thermometer, see the Operating Instructions manual that is provided with the thermometer, Welch Allyn P/N 70873-0000D

NOTE: For information on the Welch Allyn Sure Temp Plus Thermometer, see the Operating Instructions manual provided with the thermometer, Datascope P/N 0992-00-0198

NOTE: The Welch Allyn thermometers do not report the measurements to the Accutorr Plus trend memory.

An optional Datascope Predictive Thermometer Module (PTM) is available to connect to the Accutorr Plus. The Predictive Thermometer provides temperature measurements in approximately 30 seconds. The Predictive Thermometer module takes oral, rectal or axillary temperatures.

For instructions on how to connect the temperature module see section 1.3.17.

Patient temperature depends upon the site measured. Predictive Thermometers are typically substituted for mercury thermometers to measure oral, rectal and axillary sites. While correlation among these various sites is generally good, actual temperature differences among sites will vary by patient and physiological activity. Consequently, attempts to estimate the temperature of one site based on the temperature of any other site (e.g., rectal temperature vs. axillary temperature) have met with less than favorable results.

WARNING: It is essential that a single use disposable probe cover is used when taking temperature measurements.

1.3.11.1 Predictive Thermometer Measurements

When the predictive thermometer probe is removed from its holder, the Interval/Elap. Time/Temp display shows 85°F (29.4°C). This is an internal self test feature. Once the probe is in place in the patient and the probe detects a temperature greater then 85°F (29.4°C) , the Time/Temp display will begin flashing. When the temperature measurement is complete, the display will stop flashing and a beep tone is sounded. NOTE: After a measurement allow 60 seconds for the tip to cool before proceeding with the next measurement.

1.3.11.2 How to Apply Probe Cover (PTM)

1. To open probe cover box, remove the "tear out" tab on the end of the box top.

2. Place the box of probe covers into the holder of the thermometer module with the opening to the bottom.

3. Remove the probe from its chamber in the thermometer. This turns on the thermometer.

4. Insert the probe into a probe cover in the box, and push firmly on the cap of the probe handle until you feel the probe cover "snap" into place.

PRECAUTION: Use only Datascope recommended probe covers. Use of any other probe cover may result in erroneous readings or damage to the probe.

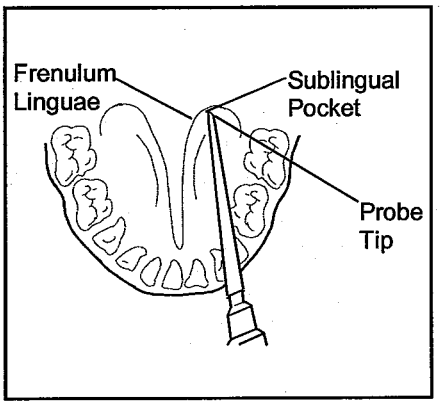


Figure 1-14 Probe Placement for Oral Temperatures

1.3.11.3 How to take Oral, Rectal, and Axillary Temperatures

1. ORAL TEMPERATURES - Using the BLUE oral probe assembly, place the probe tip firmly in the sublingual pocket next to the frenulum linguae (the vertical fold of tissue in the middle of the tongue) toward the back of the mouth. NOTE: Accurate temperatures can only be obtained in the "heat pocket" at this location. Temperatures in other locations in the mouth may vary by two degrees F (one degree C) or more. Hold the probe steady in this location. The patient's mouth must be closed for the measurement. The thermometer reading will begin to flash, then will indicate the rising temperature as the measurement proceeds.

2. The display will stop flashing and a beep tone is generated when the final temperature has been reached. The final reading will be displayed for approximately 1 minute.

3. Remove the probe from the patient's mouth, and discard the used probe cover by pressing on the button on the probe handle. Discard the used probe cover according to standard hospital procedures.

4. After the Accutorr Plus records the patient's temperature, replace the probe in the probe chamber (50). Wait at least 60 seconds before taking another temperature to allow probe to cool down.

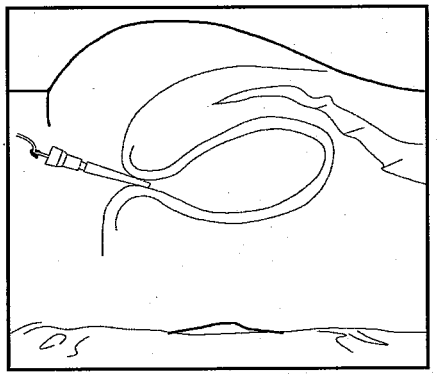


Figure 1-15 Probe Placement for Rectal Temperatures

5. RECTAL TEMPERATURES - Use a RED rectal probe assembly. Install a probe cover as instructed for oral temperatures, and insert the probe into the patient's rectum. To insure proper tissue contact, angle the probe slightly after insertion. Insertion depth is recommended at ½" to 3/4" for adults and 1/4" to ½" for children. A lubricant may be used if desired. The measurement will proceed

similarly to the oral measurement, and the final reading will be displayed when the display stops flashing.

6. AXILLARY TEMPERATURES - Using the RED rectal probe, install a new probe cover in the normal manner. Have the patient raise his/her arm. Place the probe tip in the axilla, pressing gently to assure good contact. Have the patient lower his/her arm, holding the probe in position almost parallel to the arm. The measurement will proceed similarly to the oral measurement, and the final reading will be displayed when the display stops flashing.

NOTE: It is important that the tip of the probe does not come into contact with a heat source (i.e., hands or finger) prior to taking a temperature. If this should happen, allow at least 5 seconds for the tip to cool before proceeding with the reading.

NOTE: The thermometer will turn itself off about 3 minutes after turning it on, or when the probe is returned to the probe chamber (50). Always store the probe in the chamber, or disconnect it completely to obtain maximum battery life.

NOTE: The thermometer will not take a reading if the patient temperature is less than 6°F (3.3°C) above the ambient temperature.

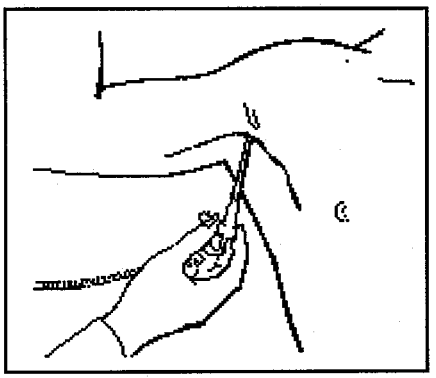


Figure 1-16 Probe Placement for Axillary Temperatures

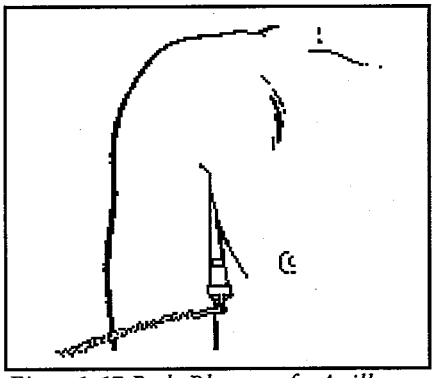


Figure 1-17 Probe Placement for Axillary Temperatures

1.3.12 RECORDER (optional)

The Accutorr Plus can provide a permanent record of patient data using the PRINT key (12). There are two print modes available. They are Continuous Print or Request Print. In the Continuous Print mode the printer will print each time there is a valid NIBP or Temperature measurement. In the Request Print mode the printer will print all of the stored information for the displayed patient.

1. Attach the Recorder Module as shown in section 1.3.17.

2. Press the PRINT key (12) (1 beep tone) to generate a Request printing. The recorder will print all stored measurements for the currently displayed patient. Press the PRINT key (1 beep tone) while a printing is in progress, to stop the printing.

3. Press and hold the PRINT key (12) (2 beep tones, approx. 3 seconds) to switch the print mode between Continuous and Request. When in the Continuous mode the Print LED (13) is illuminated.

NOTE: When a printing is in progress and the PRINT key is pressed or Room Number and/or Bed Letter is changed, the printing will stop.

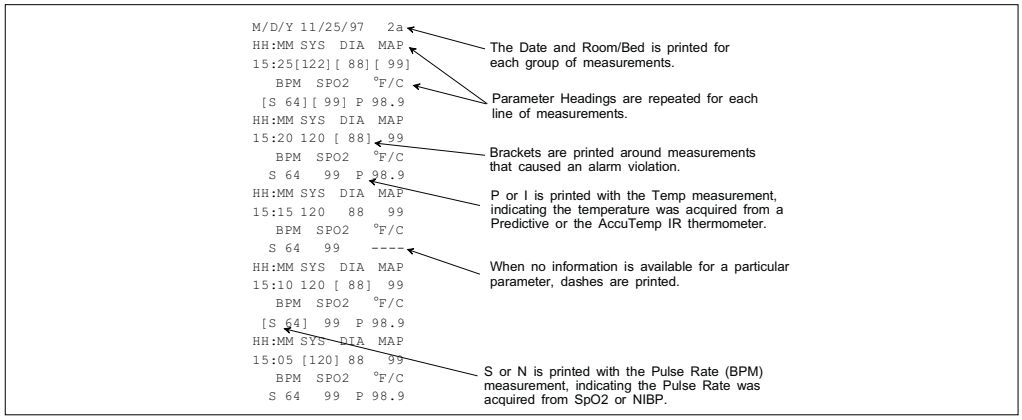


Figure 1-18 Recorder Strip Sample

When the Predictive thermometer is used, "P" is printed next to the temperature measurement. When the IR thermometer is used, "I" is printed next to the temperature measurement. When NIBP is used to obtain a pulse rate measurement, "N" is printed next to the pulse rate measurement. When SpO_2 is used to obtain a pulse rate measurement, "S" is printed next to the pulse rate measurement. If data is not available for any given parameter, "---" is printed under that parameter. Parameter values that violated alarm limits are indicated by the brackets "{ }".

1.3.13 HOW TO SET THE CLOCK (Date and Time)

The clock can be set during normal operation or in the User Configuration. See section 1.3.15, for details on entering the User Configuration. The Timer/Temp key (32), Interval/Elap. Time/Temp Display (33), and the Up and Down arrow keys (27 & 28) are used to set the time and date. **PRECAUTION:** Changing any part of the time or date will cause all stored patient information (trend data) to be permanently erased. Viewing the time or date does NOT cause data to be erased.

1. Press and hold the Timer/Temp key (32) (2 beep tones, approx. 6 seconds). The hour digit only displays.
2. Press the Patient Info. Up or Down Arrow key (27 or 28) to change the number. NOTE: The Accutorr Plus always displays time in a 24 hour format.
3. Press the Timer/Temp key (32) to activate the minute display.
4. Press the Patient Info. Up or Down Arrow key (27 or 28) to change the number. Continue pressing the Timer/Temp key and the Arrow keys to set the month, day, and year (in that order).
5. After the year has been selected, the next press of the Timer/Temp key (32) exits the clock set mode and enters the new information.

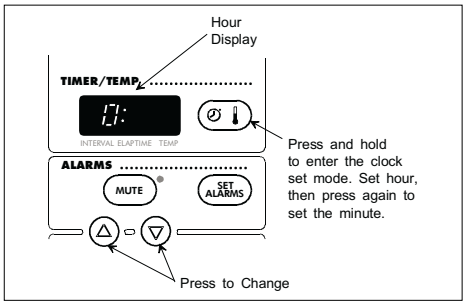


Figure 1-19 - Setting the Hour

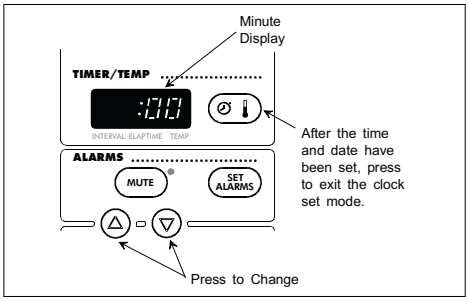


Figure 1-20 - Setting the Minute

To cancel a changed value while that value is still displayed, press the DEFAULTS key (14) for less than 3 seconds.

If the TIMER/TEMP or Arrow keys have not been pressed for 15 seconds, the Accutorr Plus returns to normal operation and saves any Time/Date changes.

When the clock is displayed, it displays real-time (current time). When the clock is displayed while viewing previous data, frozen time is displayed. When frozen time is displayed, the colon between the hours and minutes is illuminated continuously. When real-time is displayed the colon between the hours and minutes flashes.

1.3.14 BATTERY OPERATION

When the Accutorr Plus is powered from the battery, the Battery Indicator (17) is illuminated continuously.

To conserve power, most displays will blank (time out) at user selected times. The LCD illumination time out can be set between 3 and 15 minutes. The LED displays time out can be set between 5 and 60 minutes. Since the Accutorr Plus can be powered from either an AC or DC source, the user configuration allows the setting of separate times for each type of power source. See User Configuration, section 3.15 for more information on setting the time out minutes.

When the battery charge is low, but not below the cutoff voltage, the battery LED will flash and the recorder will not operate. When the LED begins to flash on Sealed lead acid units, approximately 30 minutes of battery time remain for the Accutorr Plus NIBP, 20 minutes for the Accutorr Plus NIBP with Trend Screen and 10 minutes for the Accutorr Plus NIBP with Trend Screen and SpO_2. Units with Lithium ion batteries will provide approximately 10 minutes of low battery warning time.

When the battery charge drops below the cutoff voltage the Accutorr Plus will automatically turn off. Patient information will be retained for later use.

Battery run time for the Accutorr Plus NIBP is approximately 5 hours with a Sealed lead acid battery or 8 hours with a Lithium ion battery using a new fully charged battery at 25°C with a NIBP measurement taken every 5 minutes and the recorder not in use. Battery run time for the Accutorr Plus NIBP with Trend Screen is approximately 3 hours for a Sealed lead acid battery or 8 hours for a Lithium ion battery using a new fully charged battery at 25°C with a NIBP measurement taken every 5 minutes and the recorder not in use. Battery run time for the Accutorr Plus NIBP with Trend Screen and Datascope SpO_2 is approximately 1.5 hours for a Sealed lead acid battery or 3.5 hours for a Lithium ion battery using a new fully charged battery at 25°C with a NIBP measurement taken every 5 minutes continuous SpO_2 measurement and the recorder not in use. Battery run time for the Accutorr Plus NIBP with Trend Screen and Masimo or Nellcor SpO_2 is approximately 2 hours for a Sealed lead acid battery or 4.5 hours for a Lithium ion battery using a new fully charged battery at 25°C with a NIBP measurement taken every 5 minutes continuous SpO_2 measurement and the recorder not in use.

The Accutorr Plus automatically recharges the battery, when required, when the unit is plugged into an AC receptacle. Maximum battery recharge time is 8 hours for Sealed lead acid or 2 hours for Lithium ion.

CAUTION: To avoid loss of patient data (trend), do not replace the battery unless the Accutorr Plus is connected to an AC receptacle. Hospital defaults and the time are unaffected by battery replacement.

1.3.15 USER CONFIGURATION

The User Configuration Mode allows the operator the opportunity to set custom default settings. These custom default settings will be used each time the Accutorr Plus is turned on. Once the User Configuration Mode is entered, the only way to exit this mode is to turn off the Accutorr Plus using the ON/STANDBY key (19).

1. To enter the User Configuration Mode, press and hold the DEFAULTS key (14) while turning the unit ON. Release after the third beep.
2. To select a User Configuration item number, press the ROOM/BED key (24) to display the desired User Configuration Number in the ROOM and BED displays (25 & 26). See table below for User Configuration Numbers. The current default setting for that item displays.
3. Press the NIBP START key (38) to be able to change the default value. The default setting flashes.
4. Press the Patient Info. Up or Down Arrow key (27 or 28) to change the default setting.
5. Press the START NIBP key (38) to enter the changed default setting.
6. Repeat step 2 for additional choices.

The following table list the functions that can be configured in the user configuration mode.

User Configuration Number	Function	Description	Factory Default
1a	Clock Set	Setting the date and time. See section 1.3.13 for details on setting the clock.	
1b	Date Format	Set the format as M/D/Y (1231)* or D/M/Y (3112)*	D/M/Y (3112)*
2	Reserved for future use.		
3	Text / Symbols	Set the description of which alarm limit is being set, Hi and Lo or the graphic ☲☲ . Also change the Interval of OFF to ——.	The word “Hi” which will then use Hi and Lo as the indicators. OFF for Interval.
4	Patient Size	Set the default patient size to be Adult, Pediatric and Neonate.	Adult
5a	Time Out, LEDs and LCD Characters when unit is powered from AC mains.	Set how long the numeric information is displayed, when no keys have been pressed, in the LEDs and LCD before they are blanked to conserve energy. The choices are: 5, 15, 30 or 60 minutes. **NOTE:** The information is not erased.	15 minutes
5b	Time Out, LEDs and LCD Characters when unit is powered from the internal battery.	Set how long the numeric information is displayed, when no keys have been pressed, in the LEDs and LCD before they are blanked to conserve energy. The choices are: 5, 15, 20 or 30 minutes. **NOTE:** The information is not erased.	5 minutes

**1231 represents 12 months/31 days and 3112 represents 31 days/12 months.*

User Configuration Number	Function	Description	Factory Default
5c	Time Out, Light in the LCD when the unit is powered from AC mains.	Set how long the light will stay on, when no keys are pressed, in the LCD. The choices are: 3, 5, 10 or 15 minutes.	3 minutes
5d	Time Out, Light in the LCD when the unit is powered from the internal battery.	Set how long the light will stay on, when no keys are pressed, in the LCD. The choices are: 3, 5, 10 or 15 minutes.	3 minutes
6a	Adult Initial Inflation Pressure	Set the initial cuff inflation pressure for an adult size patient. The choices are: 100 to 260 mmHg at 5 mmHg increments.	180 mmHg
6b	Pediatric Initial Inflation Pressure	Set the initial cuff inflation pressure for a pediatric size patient. The choices are: 60 to 180 mmHg at 5 mmHg increments.	140 mmHg
6c	Neonate Initial Inflation Pressure	See the initial cuff inflation pressure for a neonate size patient. The choices are: 40 to 120 mmHg at 5 mmHg increments.	100 mmHg
7	Adaptive Inflation	Choices are ON or OFF. If User Configuration #3 is set to display graphics, the choices are -l- or -O-.	ON
8	Interval Setting	Set the NIBP Interval Time. The choices are: OFF (or ——), Cont. (Continuous), 1, 2.5, 5, 10, 15, 20, 30, 60, 120, and 240 minutes.	OFF (or ——)
9a	Adult Alarm Limits	Set the default alarm limit values for an Adult size patient. See Section 1.3.5 for details on setting alarm limits.	OFF, except SpO_2 low which is 86
9b	Pediatric Alarm Limits	Set the default alarm limit values for a Pediatric size patient. See Section 1.3.5 for details on setting alarm limits.	OFF, except SpO_2 low which is 86
9c	Neonate Alarm Limits	See the default alarm limit values for an Neonate size patient. See Section 1.3.5 for details on setting alarm limits.	OFF, except SpO_2 low which is 86
10a	Alarm Volume	Set the volume of an alarm signal. The choices are: 1, 2, 3, 4 & 5. 5 is the loudest.	4
10b	SpO_2 Volume	Set the volume of the SpO_2 beep. The choices are: Off (or ——), 1, 2, 3, 4 & 5. 5 is the loudest.	OFF
11	Continuous Print	Choices are ON or OFF. If User Configuration #3 is set to display graphics, the choices are -l- or -O-.	OFF
12	Reset to Factory Defaults	To change all of the User Configuration items back to the Factory Defaults, while in User Config. #12, press and hold the START NIBP key for 3 seconds.	

1.3.16 STATUS AND ERROR CODES

The Accutorr Plus uses the various displays on the front panel to display the operational status. Status and error codes listed below can generally be resolved by the user however, some error codes, which are marked with an asterisk (*), may require resolution by a qualified technical service person. These codes with their descriptions are listed on the back of the Quick Reference card. NOTE: Status codes 8810 through 8858 can be cleared from the Room and Bed displays by pressing the Room/Bed key (24).

Status and Error Code Table

TYPE	CODE	DESCRIPTION	REASON
NIBP	8810	Retry - Unable to Measure	Motion artifact, cycle time-out, weak pulsations or no pulsations. A triple beep tone is generated.
	8811	Retry - Pump Higher	Insufficient cuff pressure. A triple beep tone is generated.
	8812	Stop - Cuff Overpressure	Excessive cuff pressure detected by the software. A triple beep tone is generated.
	8813	Stop - Unable to Measure	4 successive measurement attempts failed. A triple beep tone is generated.
TEMP (PTM)	8830	Check Probe	Tissue contact may have been lost.
	8831	Replace Probe	Defective probe or connection.
	8832	Battery Low	The 9V battery needs replacement.
SpO_2	8850	No Sensor	No sensor connected.
	8851	Sensor Off	Sensor not on patient. (Datascope and Masimo SpO_2 only)
	8852	Interference	Interference on signal. (Datascope and Masimo SpO_2 only)
	8853	Pulse Search	Unit cannot find signal. (Nellcor SpO_2 Module will report "Pulse Search" -8853- when the sensor is not on the patient.)
	8854	Weak Pulse	Weak pulse detected. (Datascope and Masimo SpO_2 only)
	8855	No Pulse	No pulse detected. (Datascope SpO_2 only)
	8856	Check Sensor	Sensor problem. (Datascope and Masimo SpO_2 only)
	8857	PR<30	Pulse rate is less than 30 bpm. (Datascope SpO_2 only)
	8857	PR<21	Pulse rate is less than 21 bpm. (Nellcor SpO_2 only)
	8857	PR<26	Pulse rate is less than 26 bpm. (Masimo SpO_2 only)
	8858	PR>249	Pulse rate is greater than 249 bpm. (Nellcor SpO_2 only)
	8858	PR>239	Pulse rate is greater than 239 bpm. (Masimo SpO_2 only)
	8858	PR>250	Pulse rate is greater than 250 bpm. (Datascope SpO_2 only)
SYSTEM	984*	NIBP Hardware Failure	NIBP A/D failure detected.
	985*	NIBP Overpressure Circuit not Programmed	The overpressure circuit is not set to the current patient size.
	986*	NIBP Overpressure Circuit not Tracking	The two pressure transducers are not tracking each other.
	987*	Stop - Hardware Overpressure	Excessive cuff pressure detected by hardware over-pressure sensor. A triple beep tone is generated.
	988*	TEMP Bad Calibration	Thermometer needs calibration.
	990*	TEMP Illegal Mode	Thermometer switch is set wrong.
	991*	TEMP Module Failed	Thermometer internal failure.
	995*	SpO_2 Uncalibrated	SpO_2 fails calibration check.
	996*	SpO_2 Failure	SpO_2 failed self-test.

1.3.17 HOW TO ATTACH OPTIONAL THERMOMETER and RECORDER MODULES

The Accutorr Plus can be configured with a Recorder Module and Thermometer Module.

To Attach the Recorder Module:

Looking at the rear panel of the unit, the Recorder Module is attached to the right side of the Accutorr Plus.

1. Insure that the Accutorr Plus is OFF.

2. Insert the tab on the Recorder Module into the Recorder Module Connector (48) on the Accutorr Plus. Push firmly to seat properly.

3. Use the 2 screws provided to secure the Recorder Module to the Accutorr Plus.

To Attach the Thermometer Module*:*

Looking at the rear panel of the unit, the Thermometer Module is attached to the left side of the Accutorr Plus.

1. Insure that the Accutorr Plus is OFF.

2. Insert the tab on the Thermometer Module into the Thermometer Module Connector (42) on the Accutorr Plus. Push firmly to seat properly.

3. Use the 2 screws provided to secure the Thermometer Module to the Accutorr Plus.

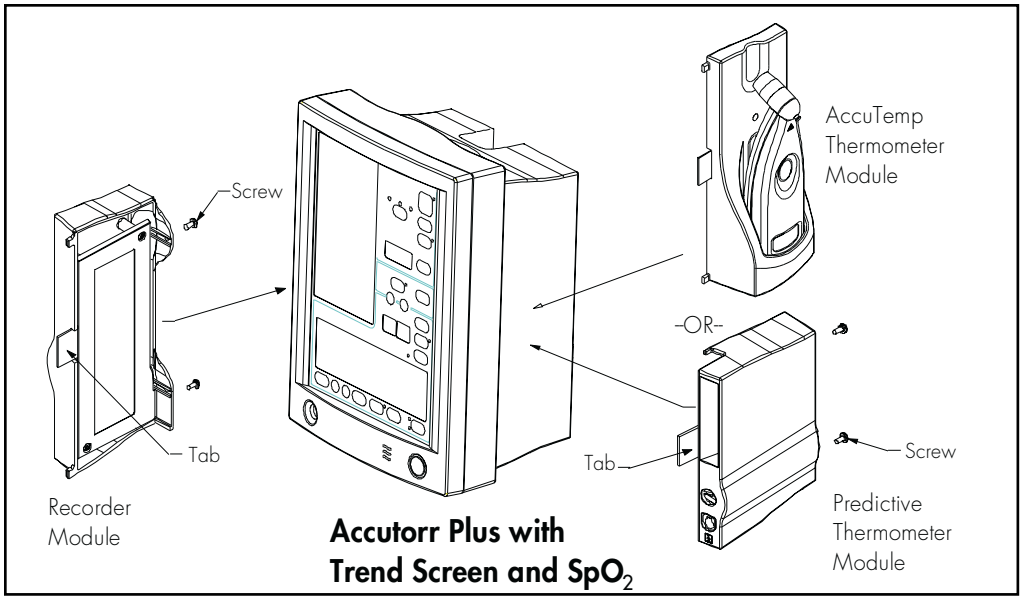


Figure 1-21 Attaching Optional Modules

1.3.18 PLACEMENT OF THE QUICK REFERENCE CARD

The Quick Reference card provides abbreviated descriptions of front panel keys on one side, and on the other side provides descriptions of the status codes. To attach the Quick Reference card, thread the NIBP hose through the two holes in the card.

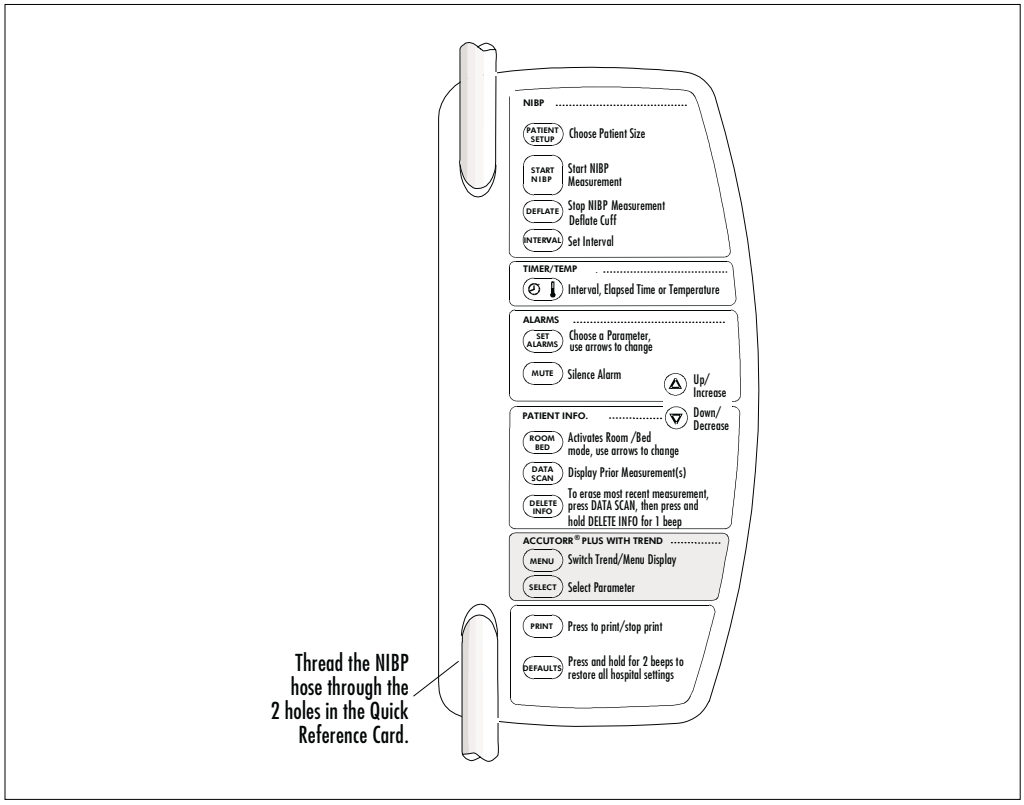


Figure 1-22 Placement of Quick Reference Label

NOTE: The card shown in figure 1-22 is a sample to show how to attach the card. The actual card may differ.

1.3.19 PLACEMENT OF RECORDER PAPER LOADING LABEL

The Recorder Paper Loading label is designed to be placed on the recorder module. Attach label as shown in the figure below.

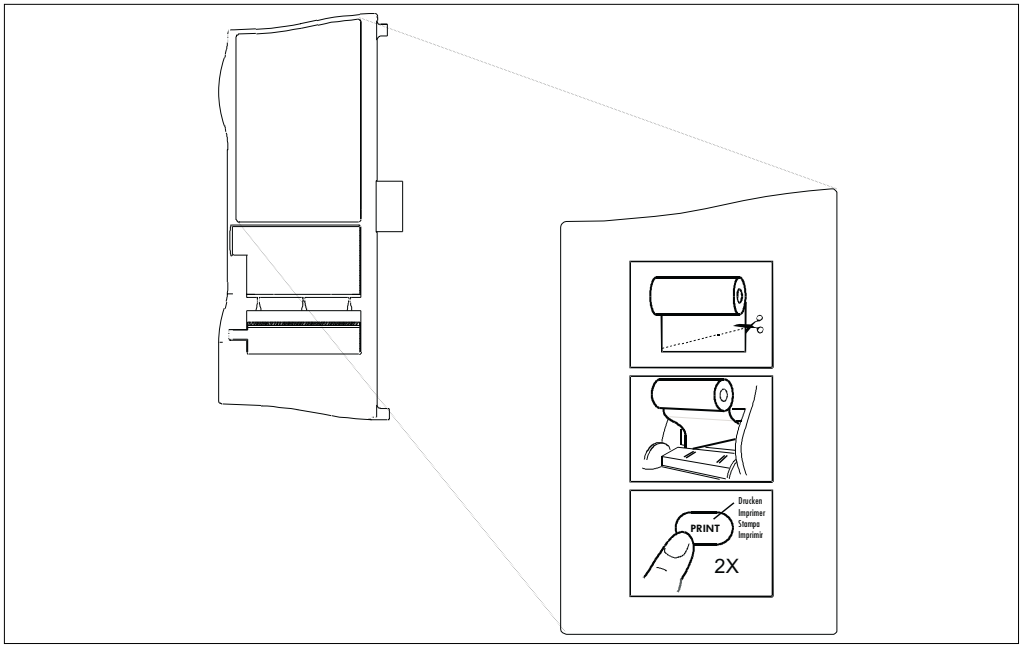


Figure 1-23 Placement of Recorder Paper Loading Label

2.0 THEORY OF OPERATION

CONTENTS OF THIS CHAPTER . . . . . Page

The Theory of Operation provides block diagrams of major operational circuits, an overview of each circuit board and functional descriptions of the major sections on that board. The information presented is intended to assist qualified service personnel to isolate faults to the lowest functional sub assembly and replacement of the same.

2.1 BLOCK DIAGRAMS

The system level block diagram illustrates the major functional modules and their interdependence. More detailed diagrams for particular functional modules are provided within the Theory of Operation.

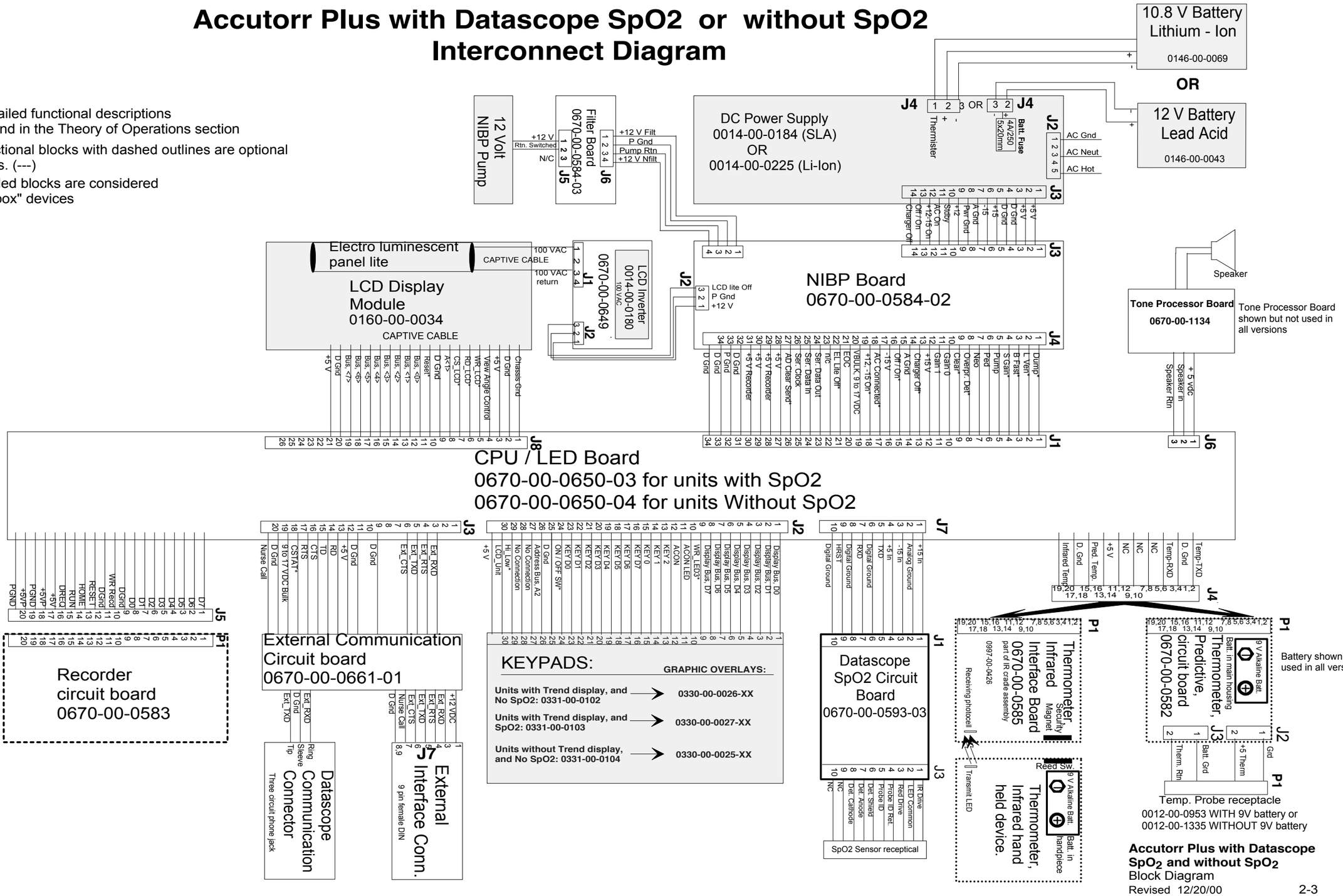
2.2 DETAILED CIRCUIT DESCRIPTIONS

This section of the manual describes the operation of each circuit block. Refer to the schematic diagrams in Chapter 5.

Included are descriptions for the following Circuit Board Assemblies:

Accutorr Plus with Datascope SpO2 or without SpO2 Interconnect Diagram

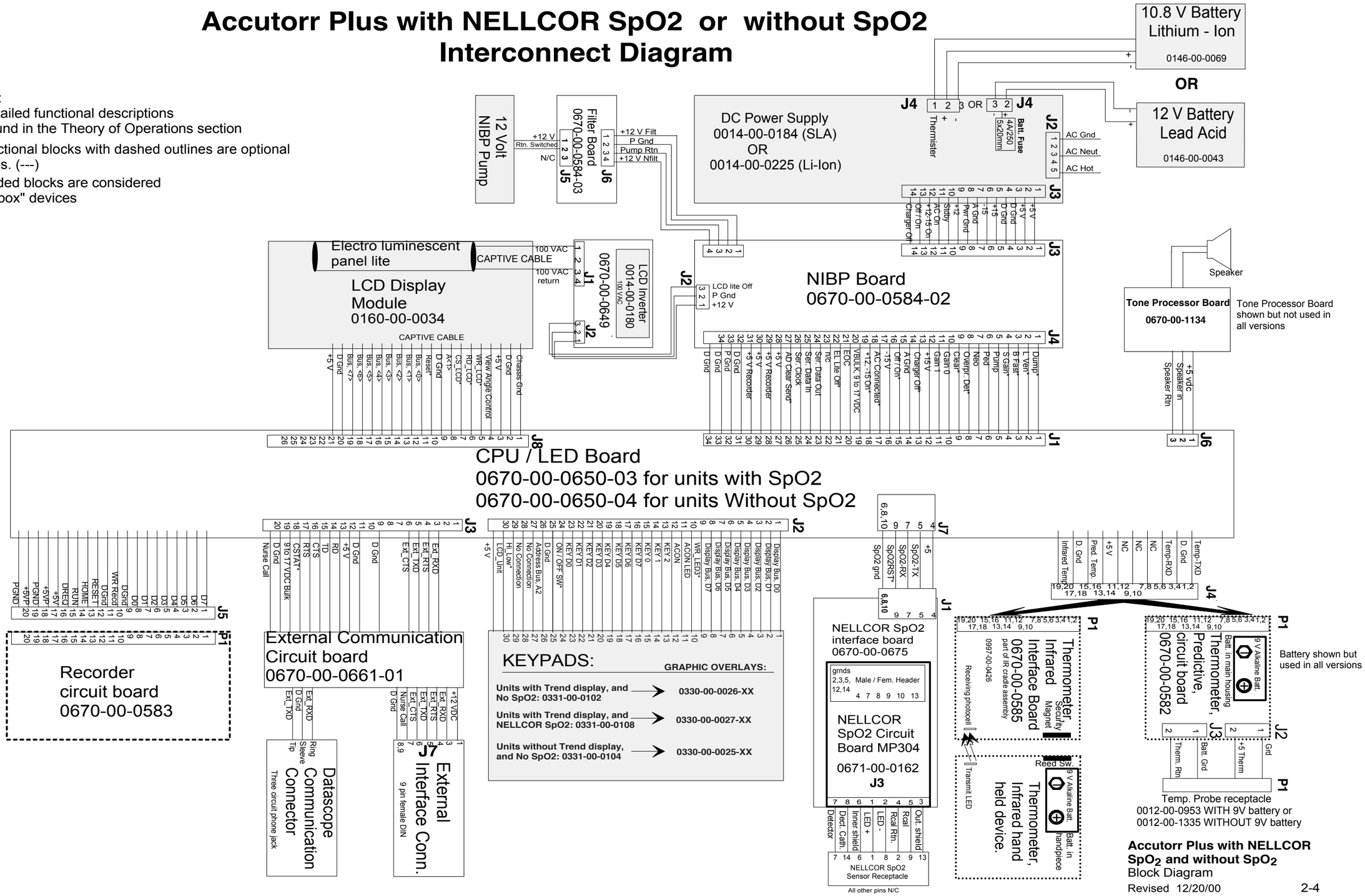
Notes:
1. Detailed functional descriptions are found in the Theory of Operations section
2. Functional blocks with dashed outlines are optional features. (---)
3. Shaded blocks are considered "black box" devices



Accutorr Plus with Datascope SpO_2 and without SpO_2
Block Diagram
Revised 12/20/00

Accutorr Plus with NELLCOR SpO2 or without SpO2
Interconnect Diagram

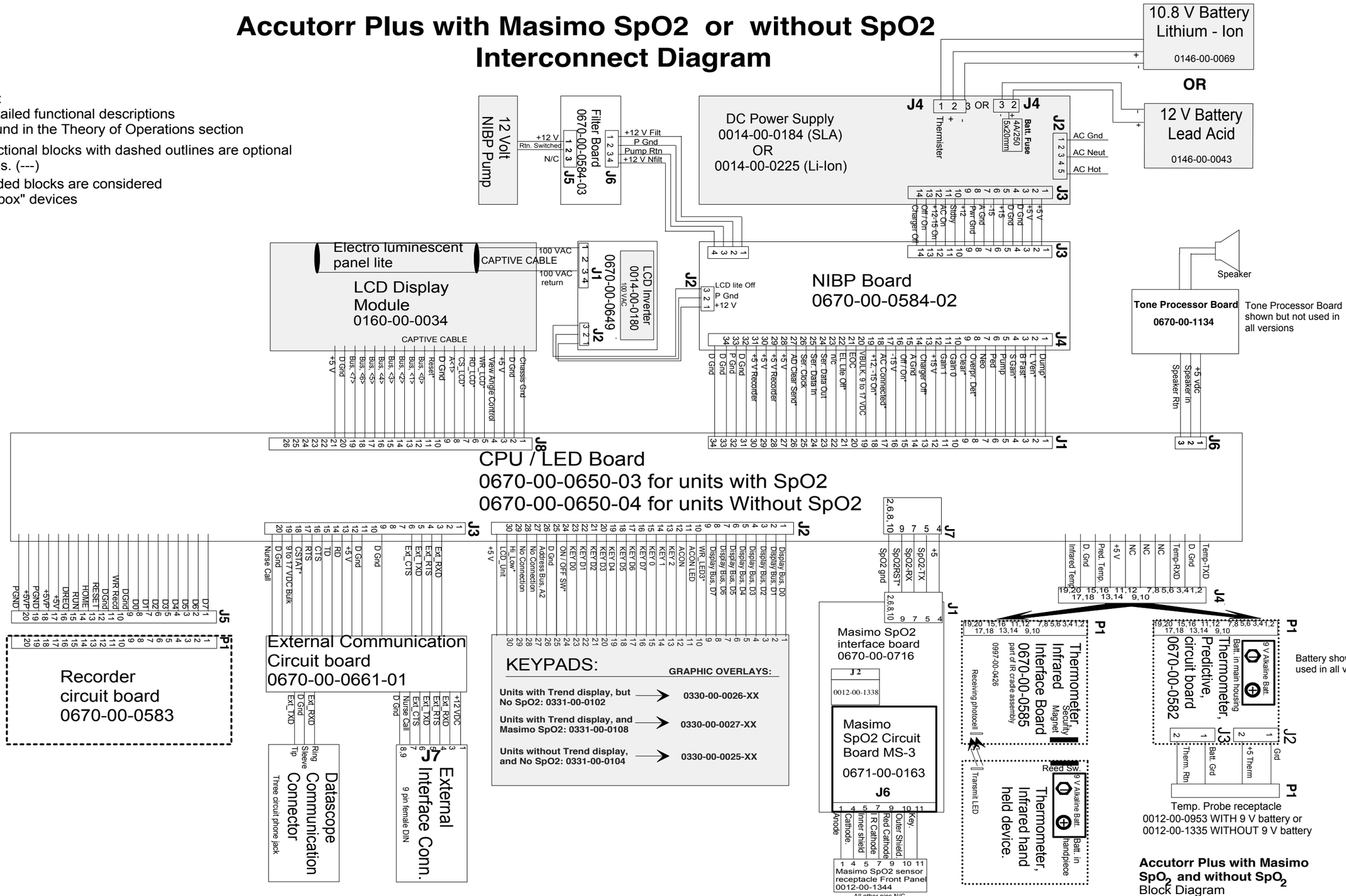
Notes:
1. Detailed functional descriptions are found in the Theory of Operations section
2. Functional blocks with dashed outlines are optional features. (---)
3. Shaded blocks are considered "black box" devices



Accutorr Plus with NELLCOR SpO$_2$ and without SpO$_2$
Block Diagram
Revised 12/20/00

Accutorr Plus with Masimo SpO2 or without SpO2 Interconnect Diagram

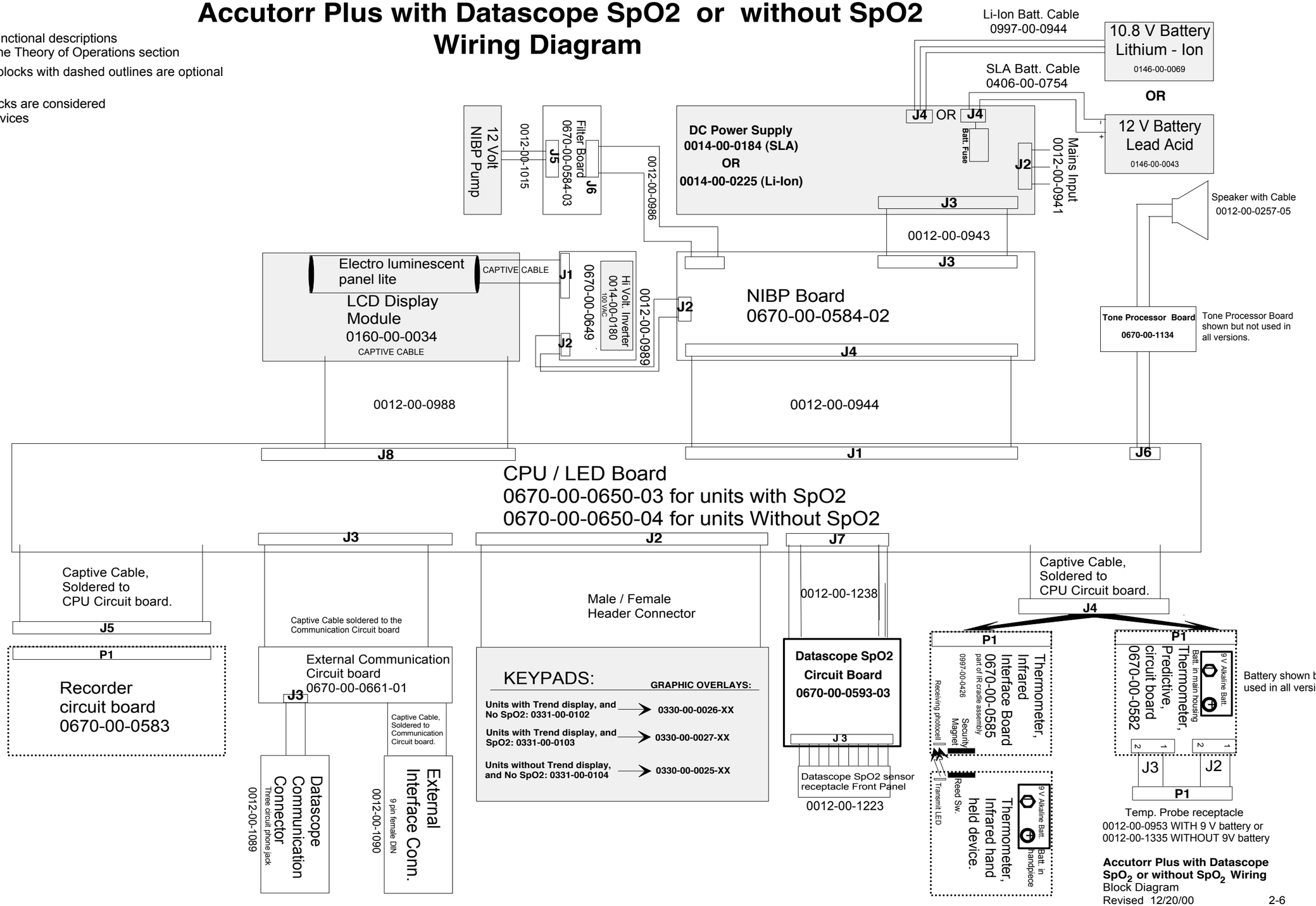
Notes:
1. Detailed functional descriptions are found in the Theory of Operations section
2. Functional blocks with dashed outlines are optional features. (---)
3. Shaded blocks are considered "black box" devices



Accutorr Plus with Masimo SpO_2 and without SpO_2
Block Diagram
Revised 12/20/00

Accutorr Plus with Datascope SpO2 or without SpO2 Wiring Diagram

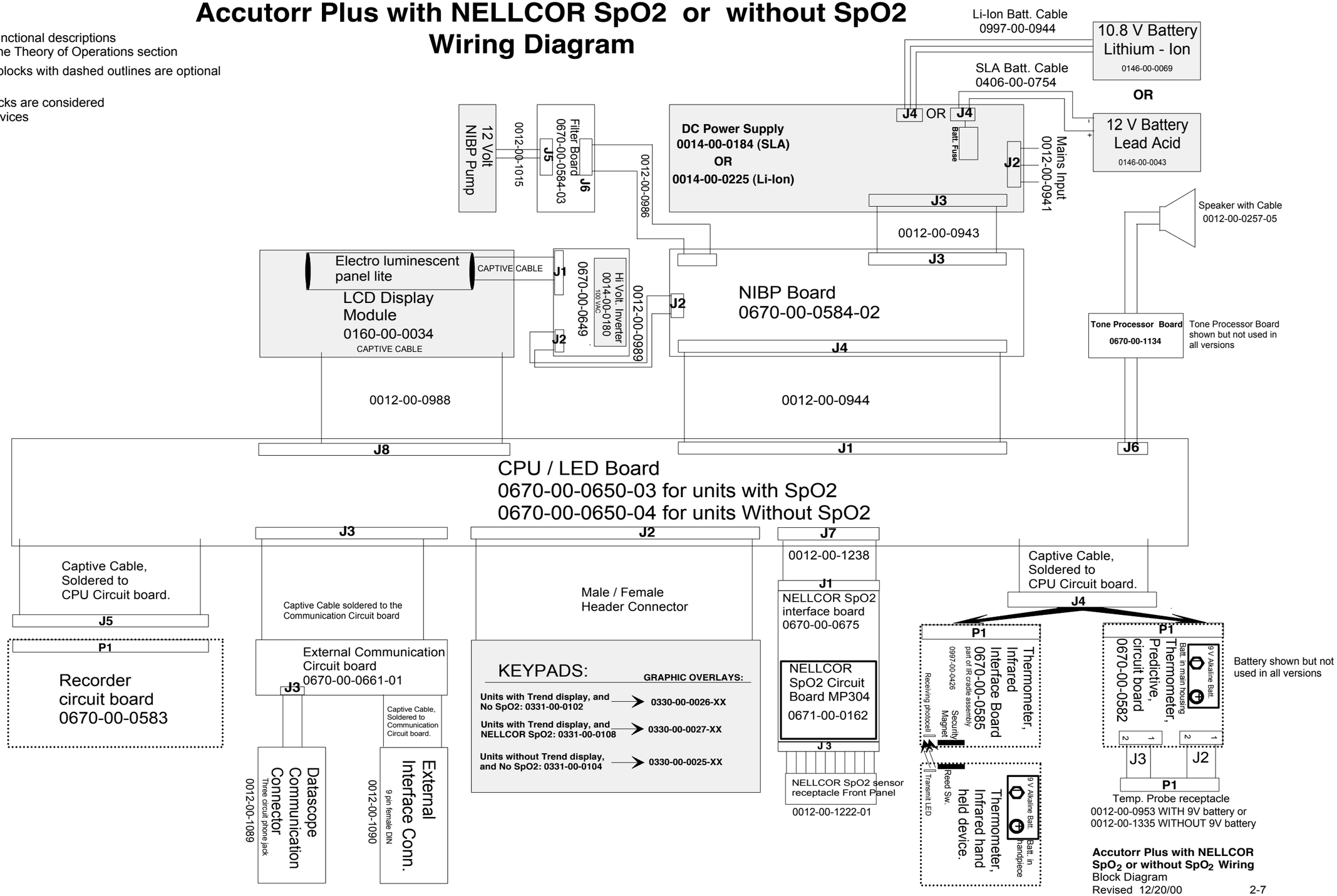
Notes:
1. Detailed functional descriptions are found in the Theory of Operations section
2. Functional blocks with dashed outlines are optional features. (---)
3. Shaded blocks are considered "black box" devices



Accutorr Plus with Datascope SpO_2 or without SpO_2 Wiring
Block Diagram
Revised 12/20/00

Accutorr Plus with NELLCOR SpO2 or without SpO2 Wiring Diagram

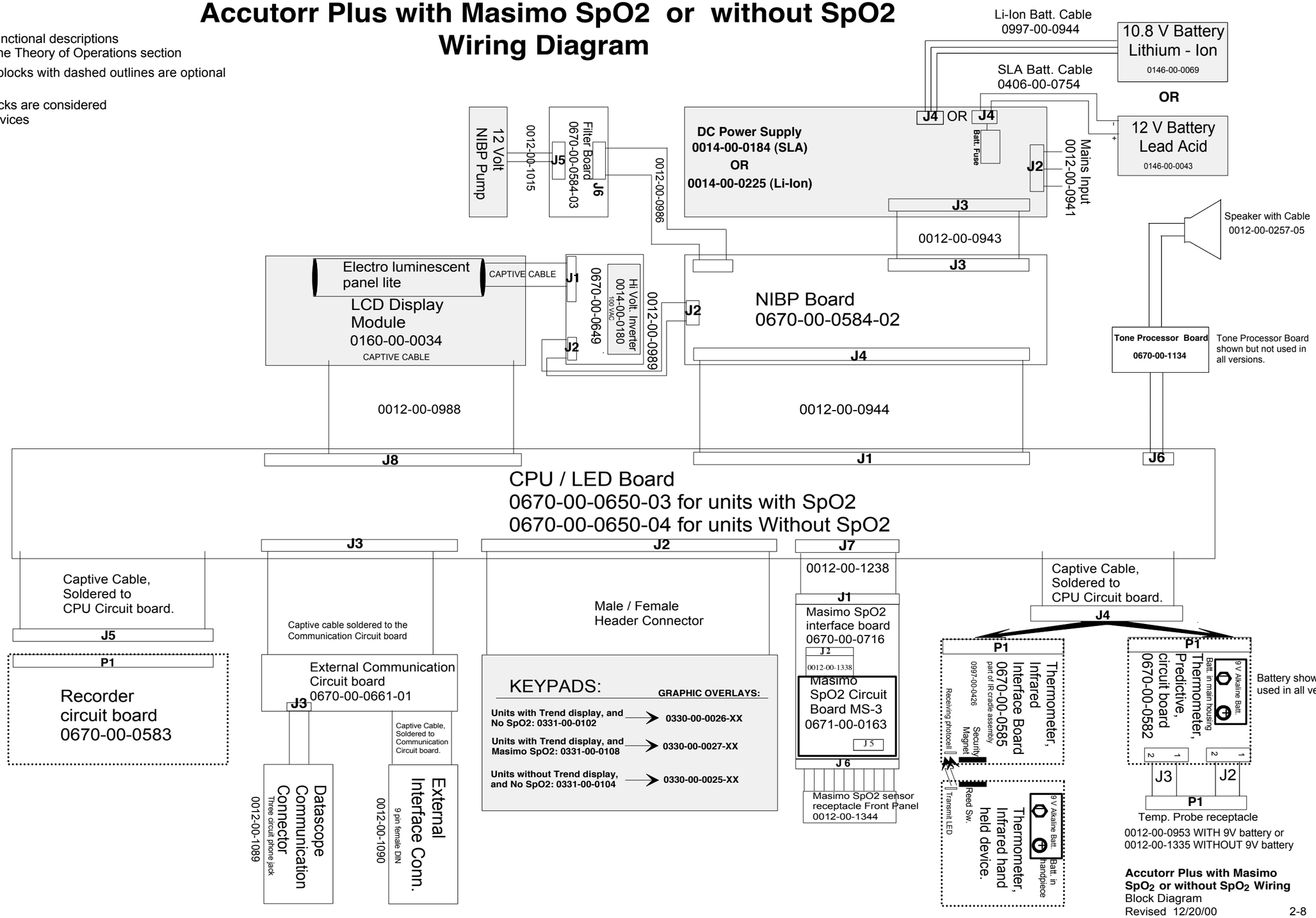
Notes:
1. Detailed functional descriptions are found in the Theory of Operations section
2. Functional blocks with dashed outlines are optional features. (---)
3. Shaded blocks are considered "black box" devices



Accutorr Plus with NELLCOR SpO_2 or without SpO_2 Wiring
Block Diagram
Revised 12/20/00

Accutorr Plus with Masimo SpO2 or without SpO2 Wiring Diagram

Notes:
1. Detailed functional descriptions are found in the Theory of Operations section
2. Functional blocks with dashed outlines are optional features. (---)
3. Shaded blocks are considered "black box" devices



Accutorr Plus with Masimo SpO_2 or without SpO_2 Wiring
Block Diagram
Revised 12/20/00

2.2.1 LED/CPU Module - 0670-00-0650-03, -04

The 0670-00-0650-03 is specified to be used with the Accutorr Plus NIBP with Trend Screen and SpO_2. The 0670-00-0650-04 is specified to be u**sed with Accutorr Plus NIBP and the Accutorr Plus NIBP with Trend Screen.**

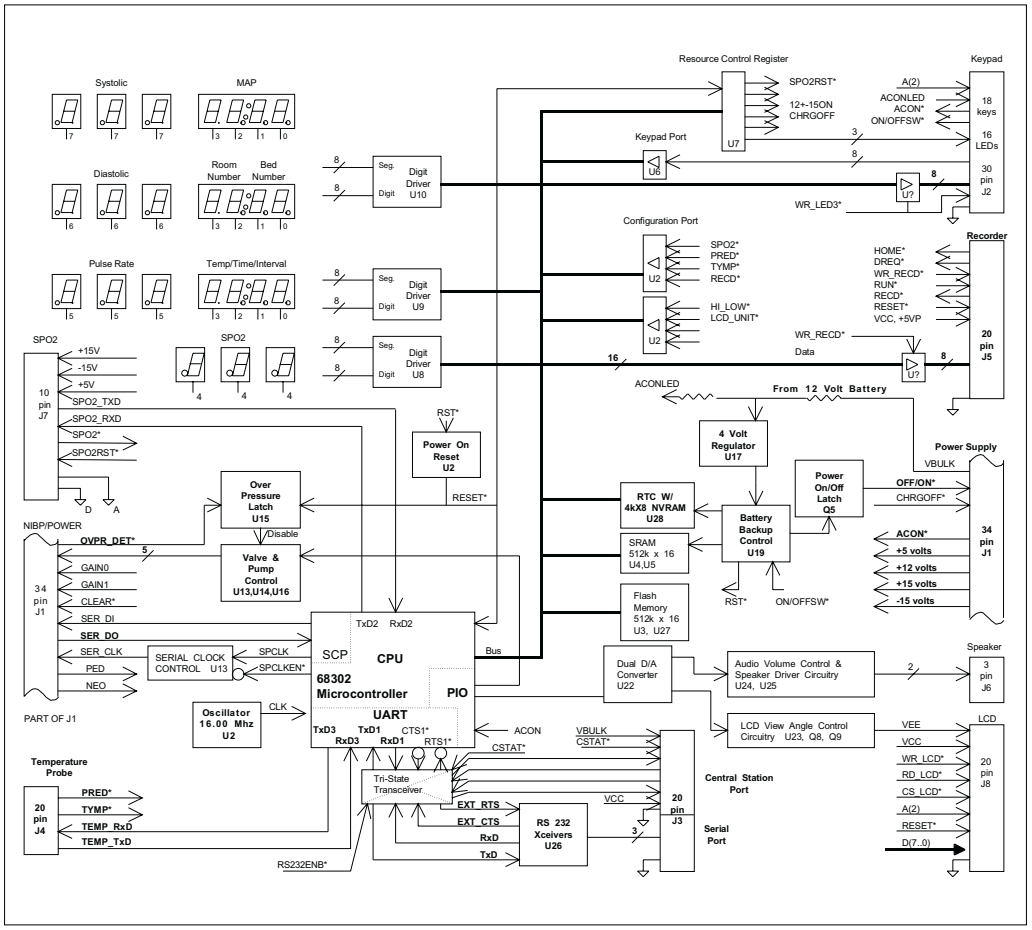


Figure 2-3

LED/CPU Block Diagram

2.2.1.1 Hardware Overview

The Accutorr Plus LED/CPU module controls the functions of the NIBP, receives input data from the keypad, temperature probes and SpO_2 module, transmits output data to the recorder, drives the LCD display, speaker, and LEDs, is an interface connection for central station support and has a serial I/O port for PC communication.

2.2.1.2 Software Overview

The software performs the following functions:

1. Initialize hardware and software modules.

   microcontroller ports and communications (serial) interfaces

   software entry points and variables

2. Perform power up diagnostics.

   microcontroller, FLASH, and STATIC RAM tests

3. Perform NIBP functions.

- start measurement
- repeat measurement
- overpressure limit
- enter or exit text mode
- abort measurement
- enter or exit calibration mode
- update alarm limits
- report alarm status
- report data
- determine inflation pressure
- perform controlled cuff deflation
- monitor DC and AC pressure and acquire pulsations
- decide on termination point and exhaust cuff pressure
- smooth pulsation data
- determine systolic, mean, diastolic pressure and heart rate
- check alarm conditions

4. Transmit/Receive data to/from Temperature module.

5. Manage Recorder functions.

6. Manage Keypad interface.

7. Drive Seven Segment LED.

8. Provide RS232 communications to PC and support software download.

9. Support Service Diagnostics.

2.2.1.3 Detailed Hardware Description

Microcontroller, U1

Device U1 is an MC68302, which contains a 68000 core CPU, a 24-bit address bus and a 16-bit data bus. Clock oscillator, Y2, shall operate at a clock speed of 16MHz which is used to clock U1. Three serial channels are used. One for communication to the temperature modules via J4. The second for communication to an external port for PC applications via J3. The third for communication to the SpO_2 module. The MC68302 also offers a Serial Communication Port (SCP), which interfaces to the NIBP A/D. The recorder interface is via the IDMA channel with buffering through a transceiver of all data to the recorder.

The power-on reset to the microcontroller and the rest of the system is generated by a DS1239 micromanager (U19). The DS1239 also acts as a watchdog to the microcontroller. The ST* input must see a high to low transition every 100ms maximum by the ST_WDOG* signal (an addressable signal from the microcontroller), otherwise a reset will be generated.

Upon a reset, both RESET* and HALT* will be activated through buffer U18 (74HCT125). These signals are bi-directional at the MC68302, therefore U1 could perform a system reset.

Multiple power and ground pins are used on the microcontoller. All VCC pins get a bypass capacitor to keep the local power supply quiet.

The following is a signal description for the MC68302 as it is being used in the Accutorr Plus:

FUNCTIONAL GROUP	SIGNALS	SIGNAL DESCRIPTION	I/O	ACTIVE
Clocks	EXTAL	Oscillator input	I	high
System Control	RESET*	Microcontroller Reset	I/O	low
	HALT*	Microcontroller Halt	I/O	low
	BERR*	Bus Error	I/O	low
	BUSW	Bus Width Select	I	h-16 bit
	DISCPU	Disable CPU	I	high
Address Bus	A23-A1	Bi-directional addr bus	I/O	
Data Bus	D15-D0	Bi-directional data bus	I/O	
Bus Control	AS*	Address Strobe	I/O	low
	R/W*	Read/Write	I/O	h-read l-write
	UDS*, LDS*	Upper/Lower Data strobe	I/O	low
	DTACK*	Data Transfer Acknowledge	I/O	low
Interrupt Control	IRQ1*, IRQ6*, IRQ7*	Dedicated interrupts, edge-sensitive	I	low
	IRQ7*	PWR_OFF* (Power fail-ure)	I	low
	IRQ6*	DONE* (DMA done)	I	low
	IRQ1*	OVPR* (NIBP overpressure)	I	low
Chip Select	CS0* - CS3*	Chip Select lines	O	low
Serial Communications Port	SPRXD	SER_DO (NIBP A/D data out)	I	
	SPTXD	SER_DI (NIBP A/D data in)	O	
	SPCLK	SPCLK (NIBP A/D clock)	O	high
Channel 1 UART	RXD1	EXT_RD (Receive data)	I	
	TXD1	EXT_TD (Transmit data)	O	
	CTSI*	EXT_CTS* (Clear to Send)	I	
	RTS1*	EXT_RTS* (Request to Send)	O	
Channel 2 UART/Port A	RXD2/PA0	SPO2_TXD (SPO2 xmit)	I	
	TXD2/PA1	SPO2_RXD (SPO2 rec'd)	O	
	PA2	NEO (NIBP Neonate select)	O	high
	PA3	PED (NIBP Pediatric select)	O	high
	PA4	SGAIN (NIBP Pressure Gain)	O	high
	PA5	BFAST (NIBP Bleed fast)	O	high
	PA6	LVEN (NIBP Linear Valve enable)	O	high
	PA7	DUMP (NIBP Dump valve)	O	high
	RXD3/PA8	TEMP_TXD (TEMP receive data)	I	
	TXD3/PA9	TEMP_RXD (TEMP transmit data)	O	
	PA10	GAIN0 (NIBP Pulse Gain)	O	high
	PA11	GAIN1 (NIBP Pulse Gain)	O	high
	PA12	CLEAR* (Reset NIBP pulse)	O	low

FUNCTIONAL GROUP	SIGNALS	SIGNAL DESCRIPTION	I/O	ACTIVE
Channel 2 UART/Port A	PA13/DREQ*	DREQ* (Recorder DMA Request)	I	low
	PA14	AD_CS* (NIBP A/D CS)	O	low
	PA15	DONE* (DMA done)	O	low
Port B	PB0	ELOFF* (LCD Backlight off)	O	low
	PB1	ACON (AC on)	I	high
	PB2	SPCLKEN* (SP Clk enable)	O	low
	PB3	ENPNEU*	O	low
	PB4	RS232ENB*	O	low
	PB5	DSP-CONT*	O	low
	PB6	TONE	O	high
	PB7	PUMP_ON (NIBP pump on)	O	high
	PB8	CSTAT* (RS232)	O	low
	PB9	HOME* (Recorder print head home)	I	low
	PB10	RUN* (Recorder motor on)	O	low
	PB11	EOC (NIBP A/D End of Conversion)	I	high

Address and Data Bus Dampening

Dampening resistors have been added to all Address and Data Bus lines that provide control and interface to I/O devices and the LCD, on CS2 and CS3. All address lines and data bus lines used for the Flash, SRAM and RTC/NV Ram do not have dampenig resistors. The dampening resistors are to located as close to the microcontroller, U1, as possible.

Flash memories, U3, U27

Program code is stored in two flash memories, ie., SST 28SF040, 512K x 8 addressed as upper and lower sector addressable to 256 bytes. These devices allow in circuit programmability, which will allow easy upgrades to software revisions. CS_FLSH*, will chip select these memories. Flash memory chip U3 is the Even byte and U27 is the odd byte.

Worst case for CS_FLSH* to data valid is 150ns max. Data must be valid 15ns min before MC68302 S6 falling edge. With one wait state inserted, 3.5 clock periods will occur before S6 falling edge. Therefore data will be ready 48.25ns before S6 falling edge, which will meet the requirement of 15ns min.

CMOS SRAM, U4, U5

This memory made up of two 512K x 8 SRAMs, U4, and U5. The memories are non-volatile due to the circuitry of Micromanager U19, and the Primary Battery Backup Voltage Regulator, consisting of Q7, and U17. The timing for the two SRAM's are the same. The SRAM write condition will be looked at first.

CS_RAM* must be active low 90 ns min before WR* rising edge. CS_RAM* is active 40ns max from S2 rising edge. WR* rising edge occurs when S6 falling edge occurs. With one wait state, as above for the flash memories, there will be 3.5 clock periods. Therefore, CS_RAM* will be active 168.25ns, compared to requirement of 90ns min. This will meet the write timing.

CS_RAM* to data valid is 55ns max for SRAM read. Data will be valid 162.5ns max from CS_RAM* active low. Therefore, with 3.5 clock periods to S6 falling edge, data will be valid 68.25ns before S6 falling edge. This will meet the setup to S6 falling edge of 15ns min.

Battery Backup Circuit

U17 is a 4V regulator which must supply current during battery mode. It supports the Real Time Clock, U28, Micromanager, U19, and the two SRAM's. The RTC will draw 1uA, Micromanager, 20uA, and the SRAM's, 200uA. Total current draw from U17 is 221uA max. U17 can supply 30mA @ Vin=6V. VBULK can supply 21mA max at the minimal voltage of 9.77V. The current supplied by U17 will then be minimized to 21mA.

U17 maximum input voltage is 14V. The maximum voltage at VBULK is 17V. Therefore, a resistor divider network of R11 and R12 is used in conjunction with Q7 to lower the voltage at U17-2. The maximum voltage at the Q7 base is 10.42V. Minimum Vbe for Q7 is 0.65V. Maximum Vin will be 9.77V, which is lower than 14V as discussed above.

Micromanager, U19

The micromanager is a DS1239. It performs four functions:

1. System power on/off capability.
2. Watchdog functions.
3. Create CMOS SRAM to Non-volatile memory.
4. Power monitoring of VCC.

The MC68302 specifies to be held in reset for 100ms min upon power up. The DS1239 can hold the reset line, active low for 25ms min. In order to hold the reset line down for 100ms min, then the addition of a capacitor to the PBRST* input is needed. The minimum time for the PBRST* input to reach 2.0V, logic hi to turn on unit, with a 47uF capacitor is 142ms.

The watchdog is monitored on U19-11. The maximum strobe period is 100ms. Therefore, in order for the device not to reset the system, U19-11 must be strobed 100ms max.

The DS1239 can supply 1mA through U19-2, VCC_BACK, during battery mode. The SRAM's will draw 200uA max during battery mode.

Real Time Clock and NV RAM (RTC), U28

The RTC is a bus device that will keep track of seconds, minutes, hours, date of the month, month, day of the week, and year with leap year compensation. The module contains a 10 year lithium source and internal crystal. The independent Lithium battery is a back up so that in case AC power is not on, the battery voltage will keep the time up to date.

Also included in the device is 2K X 8 nonvolatile RAM. This ram is continuous addressed above the RTC information.

NIBP Control, U13, U14, U15, U16

U15 is used to create an over pressure latch, that will monitor OVPR_DET*, for a hardware over pressure situation. When this circuit is tripped, the pneumatic drivers will be disengaged, and no NIBP functions will exist until a power-on reset occurs. The over pressure signal may have inadvertent triggers. In order for OVPR_DET* to trigger the latch, it must be active low for 66ms min, due to C11, R16, and R15.

U15, also is used for a pneumatic safety latch. In the case of a MC68302 clock failure, the pneumatic drivers will be disengaged upon a power-on reset. If the clock is running, then the software will toggle EN_PNEU*, to enable the drivers and NIBP functions will work.

Upon power on reset, the following sequence must be met in order for the over pressure and pneumatic safety latches to be initialized properly: U15-1 must go to a logic hi 76ns min before RST* rises to a logic hi, and RST* must go to a logic hi 76ns min before EN_PNEU* toggles logic low to a logic hi. The pneumatic drivers are made up of U14, U13, and U16. These gates are used for the turn on of the pump, dump valve, linear valve, and other controls. As discussed above, they will only work given the proper initialization or no fault condition.

The serial clock to the NIBP A/D, TLC2543, is controlled via U13. SPCLK comes from the SCP of the MC68302 and is gated by SPCLKEN* to form SER_CLK. SPCLK cannot be higher than 4.1MHz. AD_CS* is the enable to the chip select input of the device. EOC is an output signal of the A/D, and specifies an end of conversion. It goes hi to low and remains low until a conversion is completed and data is ready for transfer. AD_CS* must be active low for 1.425us before SER_CLK starts toggling. EOC will go low 2.2us max from last SER_CLK.

Recorder interface

The recorder interface is a buffered 8 bit parallel data bus with handshaking and reset capability through connector J5. The buffering provides pass through filtering and ESD suppression is provided by U35. WR_RECD* is driven by the LED/CPU board and used by the recorder to latch the data bus. This interface is handled by the DMA capability of the MC68302. The recorder drives two signals, DREQ*, and HOME*. DREQ* specifies to the MC68302 to send the next byte of data. HOME* will specify when the recorder has reached its starting point to begin a new line.

Temperature interface

This is a serial interface operating in one direction. The MC68302 is set up to receive serial information through connector, J4. The signals are TTL levels. Also, this connector will accept two temperature modules, one a Predictive, the other, an Infrared module. The software will query the MC68302 ports to determine if and what temperature module is installed. When the Predictive module is attached, PRED* is pulled to active low. When the Infrared module is attached, TYMP* is pulled to active low.

LED Drivers, U8, U9, U10 and U1 on the Keypanel

The seven segment LED's, and green LED's on the keypad are driven by four MAXIM ICM7218A LED Display Drivers, three on the CPU board and one on the keypad. These drivers accept parallel data in a serial format and drive common anode displays. A 'no decode' feature is available on this device which allows for greater flexibility in controlling each individual segment. The writes are performed via U11. The scan rate of the LED's is 250 Hz, with a duty time of 500us, typically. Also, the drivers can enter a shutdown mode, where typically 10uA is needed per device. The write signals, WR_LED(0..3)*, must be active low for 200ns min. Data bus, D(0..7) must be setup 250ns with respect to the write signal rising edge. The LED drivers are mapped to the CS_IO* of the MC68302 and is configured for 4 wait states. As discussed above, WR_LED0* must be active low for 200ns min. WR_LED0* will become active upon DS* going low. DS* will go low 41ns after S4 rising edge. There will be 5.5 clock periods from S4 rising edge. This amounts to 343.75ns - 41ns = 302.75ns min that WR_LED0* will be active low for. This meets the write strobe timing. As discussed above, data must be valid 250ns to WR_LED0* rising edge. Data is written by the MC68302 30ns after S4 rising edge. S4 rising edge to S6 falling edge is 343.75ns. Therefore, data is valid 313.75ns min before WR_LED0* rising edge, which is greater than 250ns.

DS1-DS6 are 7 segment 0.8" high Red LEDs. DS7-DS9 are 7 segment 0.56" high Red LEDs. DS10-DS12 are 7 segment 0.56" high green LEDs. DS13-DS15 are 4 digit 7 segment 0.28" high red LEDs, with a upper and lower colon. The driver lines for DS10 - DS12 are latched and driven by individual 74HC374A with each output driving a segment through current limiting resistors sized for the mcd intensity of each color. The data is latched by using a 74HC123 inverted output is used to latch the data. The trigger is the multiplexed anode line from the Maxim IC and the output state change is delayed a minimum of 40uS and a maximum of 200uS. This will enable the latch from 10 to 50% into the multiplx line.

The discrete LEDs on the keypad are driven by WR_LED3* which is located on the keypad. For the purpose of design control the device is contained within these design documents. This device is used to illuminate the individual LEDs on the keypad. The timing and function is the same as above.

The display controllers are 8 bit devices located on the odd address locations defined in Appendix A2. An additional data bus line, D8, is used to enable the display drivers for the SpO2 and Heart Rate. The bit is written to by either the control or data registars. The device is enabled by a high signal on D8 that is clocked in by RST_WR_LED (0..2)*.

Keypad interface

The keypad is made up of a 3 x 8 matrix of keys. U6 will monitor the array of 8 keys. It is pulled up and when a key is pressed, one of those lines will go low. An interrogation will commence from the MC68302 to find which key was pressed.

Communication Interface

The Accutorr Plus Communication module provides the communication signal interface between the LED/CPU board and the external communication interface connector. The board supports the CIS/HIS/DIAP interface via RS-232E or RS-485, providing a feed through path for the Datascope proprietary download connector (J1), the DC/DC converter (for the =12Vdc @ 100mA required for wireless telemetry), and the RS-232 driver.

SpO_2 Interface

The SpO_2 module connects to the LED/CPU module via connector J7. Power, ie., æ15V and +5V, and ground are provided by the LED/CPU module. The MC68302, interfaces with the SCC2692 of the SpO_2 module through a TTL serial interface. The SpO_2 module sends serial information via signal, SpO_2_TXD, and receives information via signal, SpO_2_RXD. The LED/CPU module can reset the SpO_2 module by asserting SpO_2RST*. The signal SpO_2* is used to provide the LED/CPU with the systolic signal used to create the heart beat.

DAC functions

U22 is a dual 8 bit DAC, that interfaces to U1, MC68302. It controls the attenuation needed for the speaker driver circuitry and the amplitude of LCD drive signal, VEE, ie., steps of 255 from 0 to -10.4 V minimum. The device is selected via the CS_IO* signal. Power to the DAC is provided by an unboard DC-DC convertor. The DAC is written to when WR_DDAC* pulses hi when CS_IO* is active low. Timing is equivalent to that discussed in section 2.3.10.

Speaker Driver

This function is driven by the MC68302 in two manners. One is the enable signal, TONE, and the other will attenuate the output signal in steps of 255 via the data bus, D(0..7). TONE is a 5V signal which is divided down by 26 to 200mV and buffered by U24, LM358. This signal is then attenuated by U22, AD7528, and buffered by the other half of U24. U25 is the speaker driver section and this amplifier is set for a gain of 20.

LCD

The LCD drive supply voltage is specified for -10.4V minimum. It can go to a maximum of 17V with respect to VDD logic supply voltage. The DAC, U22 will take +15VF as reference voltage and feed that to TL032, U23, to invert to -15V output. That is then buffered by another section of U23 and drive base of Q9. Transistor Q8 is set up as a current limiter for Q9. It monitors the current across R32. If the voltage across R32 is greater than 0.7V, ie., 21mA, then shunt drive voltage to the base of Q9 to limit the current.

Power ON Tone

The power on tone is used to inform the user the unit is powered on. The speakers amplifier is driven by an oscillator for a min. 70 mS. The device is triggered by either a press of the ON/STBY key, turning the unit on, or a reset condition. The oscillator is designed to run at approximately 600hz.

Central Station

The microcontroller has control over the external serial communications with CSTAT* and RS232ENB*. The board includes a connector, shared with the RS232, for connection to an interface PCB. This interface includes RD, TD, RTS, and CTS for communication, VBULK which is the main battery voltage, VCC for logic drive, CSTAT* for control of the interface status and DGND. VBULK is capable of supplying 1 watt of power to this module.

2.2.2 NIBP Module, Linear Bleed

Overview

The NIBP module contains only the Pneumatic and the Analog circuits. The NIBP module is controlled by the CPU on the LED/CPU module. All analog signals are converted by an on board serial A/D converter and sent serially to the CPU for processing. The NIBP module, in conjunction with the LED/CPU module, measures the blood pressure non-invasively using an inflatable cuff and the oscillometric principle.

The NIBP module is controlled by the CPU where it inflates the cuff, bleeds down the cuff pressure during measurement and engages the dump valve which relieves cuff pressure at the conclusion of the measurement. It monitors the air pressure in the cuff via a pressure transducer. It is from this signal (both AC and DC components) that it determines the NIBP of the patient via the oscillometric principle. Safety features include a hardware over pressure limit set to the corresponding limit depending on patient size selected via the control panel. This hardware pressure limit is in addition to a software controlled limit which will provide redundant fail safe operation upon a fault condition.

The “Linear Bleed” NIBP module has a single proportional valve, having a continuously variable effective orifice size. This valve is controlled by a servo loop, such that the cuff deflation rate is closely and automatically regulated to a specified value, despite changes in the cuff volume and pressure.

In addition, the NIBP module distributes the power from the power supply, which includes power and control signals to the LED/CPU module. Via the LED/CPU board, power is distributed to the rest of the system, such as the Recorder and the SpO_2 modules. Also, the NIBP module supplies separate power and control to: a) Pump filter board, which powers the NIBP pump. b) LCD back light converter.

Software Control

There are no software requirements on this board. The microcontroller for this board's functions are located on the LED/CPU board.

Hardware Functions

Pressure transducer circuitry

A pressure transducer and amplifier is provided to acquire the cuff pressure signal. Performance is consistent with pressure range and accuracy specifications for the NIBP module.

Over pressure transducer circuitry

An over pressure transducer, independent of the main pressure transducer is provided. An amplifier, a comparator with three selectable over pressure limits, and an over pressure output signal interpret the transducer state. Over pressure limits are set according to the patient size.

Five A/D channels

All channels are at 12 bit resolution and digitized at 300 Hz:

1) DC pressure
2) AC pressure (pulse)
3) Hardware over pressure transducer
4) Hardware over pressure comparator reference.
5) Battery voltage monitoring, when the Accutorr is in battery operation.

Pulse Channel Filter

A high-pass filter is provided to isolate the pulsatile component from the DC cuff pressure. This pulsatile component is digitized as the pulse channel. The gain of this AC coupled channel is programmable in a manner consistent with the specified range of pulse amplitudes. Means are provided to rapidly "reset" the filter following disturbances caused by motion or activation of the pump or valves.

Inflation Pump

A pump capable of inflating the cuff within the specified time limit.

Bleed Valve

A valve and control system capable of bleeding down the cuff pressure in accordance with the specifications.

Dump Valve

A valve to rapidly discharge the residual cuff pressure at the end of the measurement cycle.

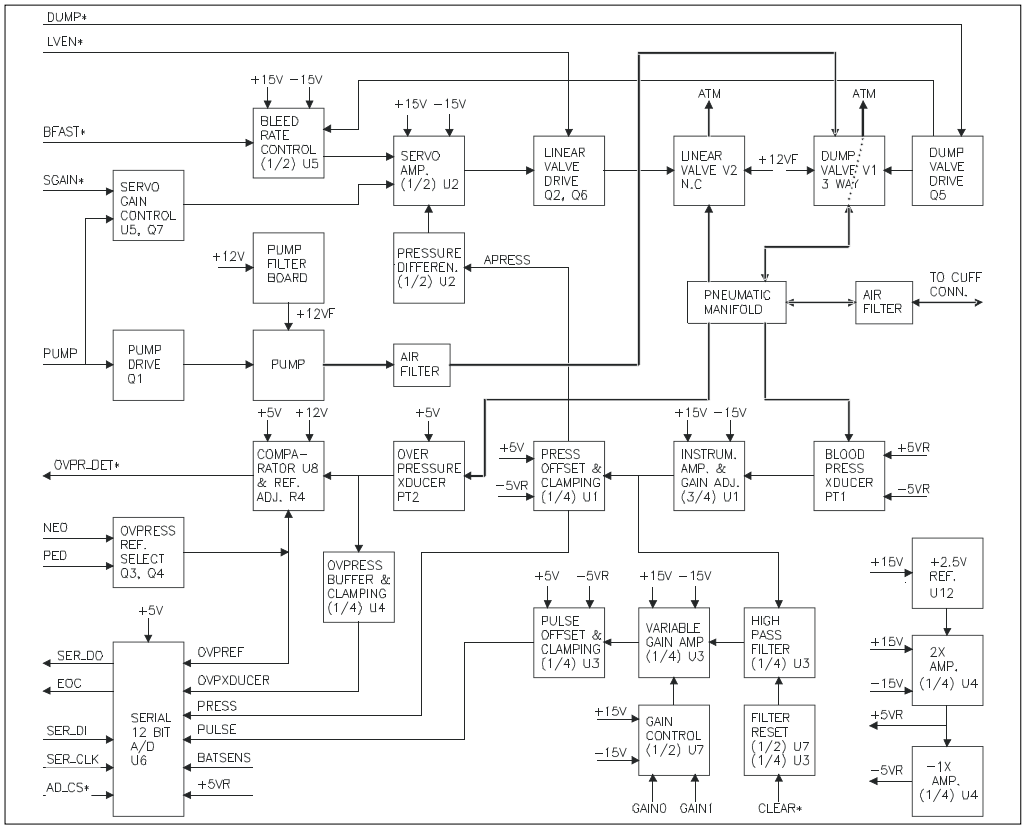


Figure 2-4

NIBP
Block Diagram

2.2.3 Recorder Module

Accutorr Plus Recorder module provides the interface from the LED/CPU module to the recorder. This module is strictly an output device for the Accutorr Plus. Data is written to the module via DMA and is then routed out to the recorder.

Software Control

There are no software requirements on this board. The microcontroller for this board's functions are located on the LED/CPU board.

Hardware Functions

Recorder Driver Circuit Board

This circuit takes all control instructions from the LED/CPU board and provides printhead drive decoding, paper drive motor control logic decoding, printhead "home switch" position sensing and pulse width modulated oscillator for print head drive.

Recorder Transport and Print Assembly

This mechanical assembly has no active electronic components. A paper drive motor, print head shuttle and print head position sensor report to the Recorder Driver circuit board.

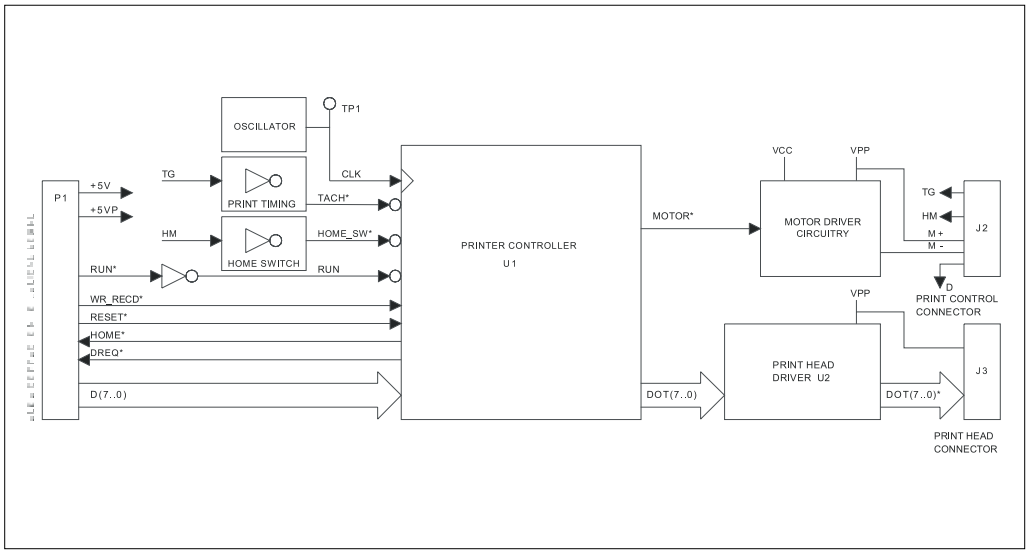


Figure 2-5

Recorder Module Control Logic Block Diagram

2.2.4 Predictive Thermometer Module

Overview

The Accutorr Predictive Thermometer Module, is an optional accessory to the Accutorr Plus or Plus with SpO_2.

The Predictive Thermometer PCB consists of 2 68HC705C8A microcontrollers (MCU) IC's (U4 and U3). MCU U2, is provided by Sherwood Medical, and its software program converts the thermistor output signal to a seven segment code used to drive a display. The second MCU U3 software program, converts the seven segment code to a serial TTL-level signal, that is isolated from the main Accutorr Monitor via opto-isolators.

Block Diagram

An overall block diagram of the Predictive Thermometer PCB is shown below. The Predictive Thermometer PCB consists mainly of a differential amplifier (ICL7612), an A/D converter (ADC0834B) and 2 microcontroller IC's that convert the analog signal of the input temperature probe to a serial TTL-level signal.

Software Control

The determination and processing software within the module is adapted under license from an outside vendor, as part of U4. Software control of data communicated to the LED/CPU board for further processing and display control.

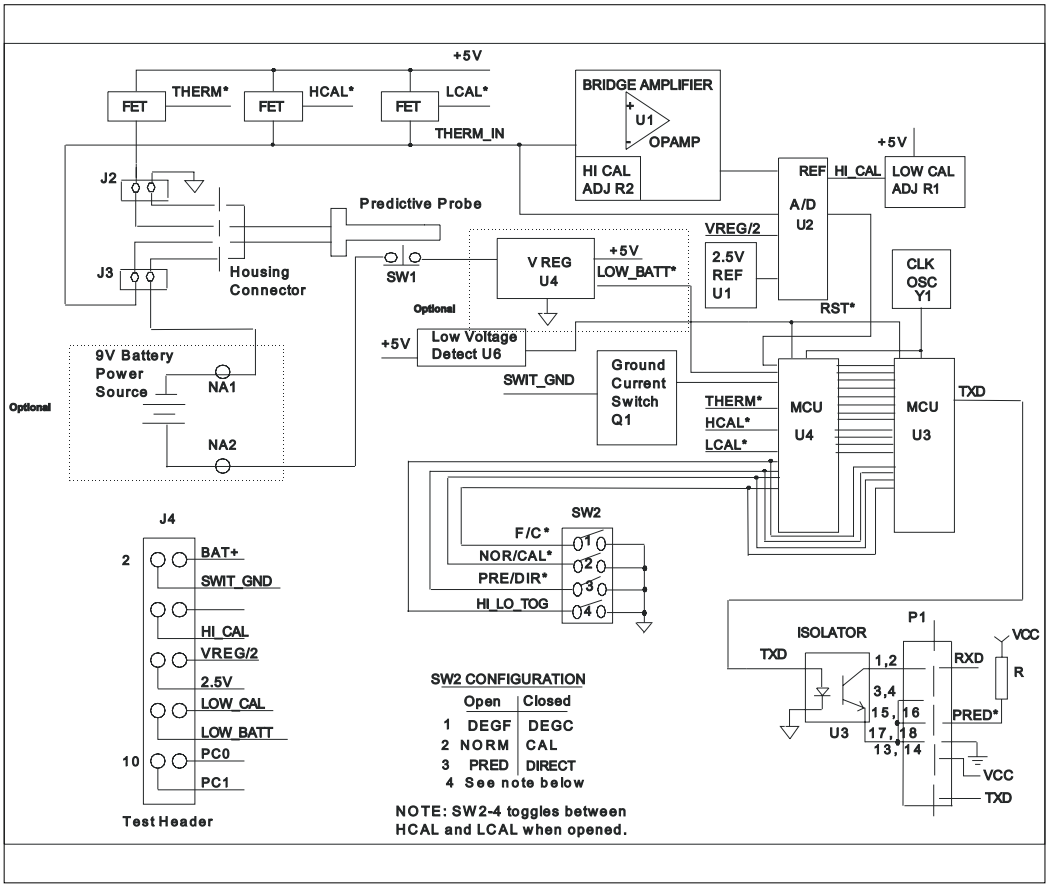


Figure 2-6

Predicative Temperature Module Block Diagram

2.2.5 SpO_2 Module: (Accutorr Plus Model with Datascope SpO_2 only)

General Theory of SpO_2 determination: A pulsatile arterial saturated oxygen monitor detects the oxygenation level of the blood in the body's arterial circulation. It is used to continuously monitor the effectiveness of the pulmonary system (lungs). Specifically the device, within limits, determines the fraction of hemoglobin molecules carrying oxygen from the lungs to the body cells. Termed % SpO_2, this fraction is normally about 97 percent.

The device measures the relative attenuation of two specific wavelengths of light (red and infrared) by the arterial blood. A sensor from the instrument contains two sets of LED's to illuminate a portion of the body (e.g., a fingertip), and a single photo-detector to sense the amount of light which exits. The two sets of LED's are alternately pulsed so that the circuitry can discriminate the infrared light. Each time the heart pulses arterial blood into the finger, the photo-detector's signals return to their original level. The electronic instrumentation processes only this changing portion of the photo-detector's outputs. Thus, arterial blood (not skin, bone, venous blood, etc.).

The determination is based upon the assumption that hemoglobin and oxyhemoglobin are the only two significant attenuators of light in the arterial blood. The device exploits the difference in their optical attenuation characteristics. But since the detector's signal is sensitive to the combined attenuation of both molecules, the device must use two different wavelengths to discriminate their individual contributions, and thus their relative concentration.

The SpO_2 Module allows the Accutorr Plus Model with SpO_2 to measure patient's blood stream saturated pulsatile oxygen level and pulse rate.

Datascope SpO_2 Module Theory of Operation, Electrical Description

The SpO_2 board consists of analog and digital sections. The analog section provides all the patient finger probe excitation and analog signal processing. The digital section controls the operation of the analog part of the board and provides communication to the rest of the Accutorr Plus with SpO_2 via the U14 DUART.

Analog Section

The operation of the analog section is controlled by the digital part of the board by:

Supplying **CLKSEQ** clock signal to the sequencer.

Latching signals **D0..7**, into control register with strobe signals **CONTROL-REG0*, CONTROL-REG1*,** and **CONTROL-REG2*.**

Monitoring **COMP*** and **SAT*** signals.

The sequencer controls the front end of analog section. It provides RD-DRV and IR-DRV signals for the LED drive circuit, which in turn alternately drive red and infrared LED emitters in the probe. A single photo-detector on the opposite side of the finger produces current pulses proportional to the amount of light received. The sequencer also sets the gain of the current to voltage pre-amp and controls the demultiplexer. Gain values for current to voltage pre-amp are derived from control register signals **IR0, IR1, RD0,** and **RD1**. The fact that the sequencer has synchronous control of LED drive, gain of current to voltage pre-amp, and demultiplexer makes it possible to set different current to voltage gain values for infrared and red signals.

The control registers provide data for the DAC and set gain values of dc gain (**DCG0, DCG1**), ac gain (**ACG0, ACG1**), and current to voltage pre-amp (**IR0, IR1, RD0, RD1**)

stages. Wide gain range gives the board enough flexibility to acquire signals from fingers spanning a wide range of thicknesses or alternatively from other sites of the body such as ears, nose or toes. It also controls the remultiplexer (**CHNLMUX**) and provides calibration signal **CAL***, which is used by the sequencer to determine the operation mode, and test signal **DIAG***, which supplies a fixed voltage source at demultiplexer input for circuit diagnostics. Again because the control registers can synchronously control the remultiplexer and gain values for ac and dc gain stages, different gain settings can be selected for red and infrared signals.

An interference detector monitors the output of current to voltage preamp for voltages less than negative 7.2 V in amplitude. This information is sent to the digital section through **SAT*** signal.

The patient probe signal enters the board as current pulses. After the signal goes through the current to voltage preamp stage it is separated by the demultiplexer circuit, which steers each voltage pulse to one of two signals, IR-CH or RD-CH. In addition, the circuit sends a negatively amplified version of the signal level between LED pulses to both channels. This residual signal is caused by ambient light on the photo-detector and offset voltages from the preceding circuitry. The negative amplification sets-up cancellation of the extraneous effect of the residual signal by the filter circuits that follow.

Signals **IR-CH** and **RD-CH** are then filtered identically by two parallel and matched filters. The filters also reduce the effect of any noise source, which might interfere with the measurement, such as an electro-surgical unit.

After passing through filter blocks red and infrared signals and are alternately selected by the remultiplexer for further processing. Next, the signal is amplified by the dc gain stage. Having the ability to apply a different gain to the two components, this block functions as a coarse equalization of the multiplexed signal.

An offset voltage, determined by the DAC, is then subtracted by the subtraction circuit. The plethysmographic waveform consists of a small component varying along with the physiological pulse, sitting on top of a larger pedestal. The subtraction circuit pulls off most of this pedestal. The subtraction circuit also helps to maintain the resultant signal in the amplifier linear region.

The residual multiplexed signal is once again processed through a microprocessor controlled ac gain block. One of a few discrete gains is chosen for each of the two components, such that the peak to peak size of the physiologically varying components is large enough to be digitized with sufficient resolution.

After passing through the ac gain stage the signal is sampled by a sample and hold and held for amplitude digitization. The digitization is performed under the microprocessor control of the digital to analog converter. The DAC voltage is successively altered by the microprocessor until it zones in on the signal being digitized. A comparator then compares the signal and DAC voltages and sends **COMP*** signal to the digital section.

The DAC thus performs a dual function. It is used in both the subtraction and the comparator blocks. Every 1/240 of a second, the circuit's control functions are flipped to process the alternate component of the multiplexed signal. The multiplexer switches signals, the two microprocessor controlled gains are changed, if necessary, and a new digital code is sent to the DAC for use in the subtraction circuit. After settling to it's new value, the signal at the input of the comparator is frozen by the sample and hold circuit. The DAC is now available to be used in the digitization. At the next 1/240 second interval, all the control signals revert to the previous values.

Digital Section

The digital section of the board performs two distinct functions: analog section control and interface to communications ic's.

This section is based on a 63C09E microprocessor. The analog section is accessed by writing data into the control registers. Address decoding for generating control register strobes **CTRL-REG0*, CTRL-REG1*,** and **CTRL-REG2*** is done by an EPLD address decoder. The same address decoder is also responsible for monitoring status lines **COMP*** and **SAT***. THE 63C09E can observe the status of these lines by reading **RD0** from the assigned memory location (See Table XIV).

A watchdog timer chip provides RST and RST* signals to initialize the processor, the three EPLD's and the two communications ICs. This watchdog is activated by any of a number of sources: 1) a dip in the +5 volt logic supply, 2) a reset from the Accutorr Plus with SpO_2 host processor board on HSTRST*, or 3) lack of a strobe from a software control loop on DOG-STR*. A 68C681 UART interface the processor to the host processor board. Processor and communications shared memory consists of both static ram and flash ram.

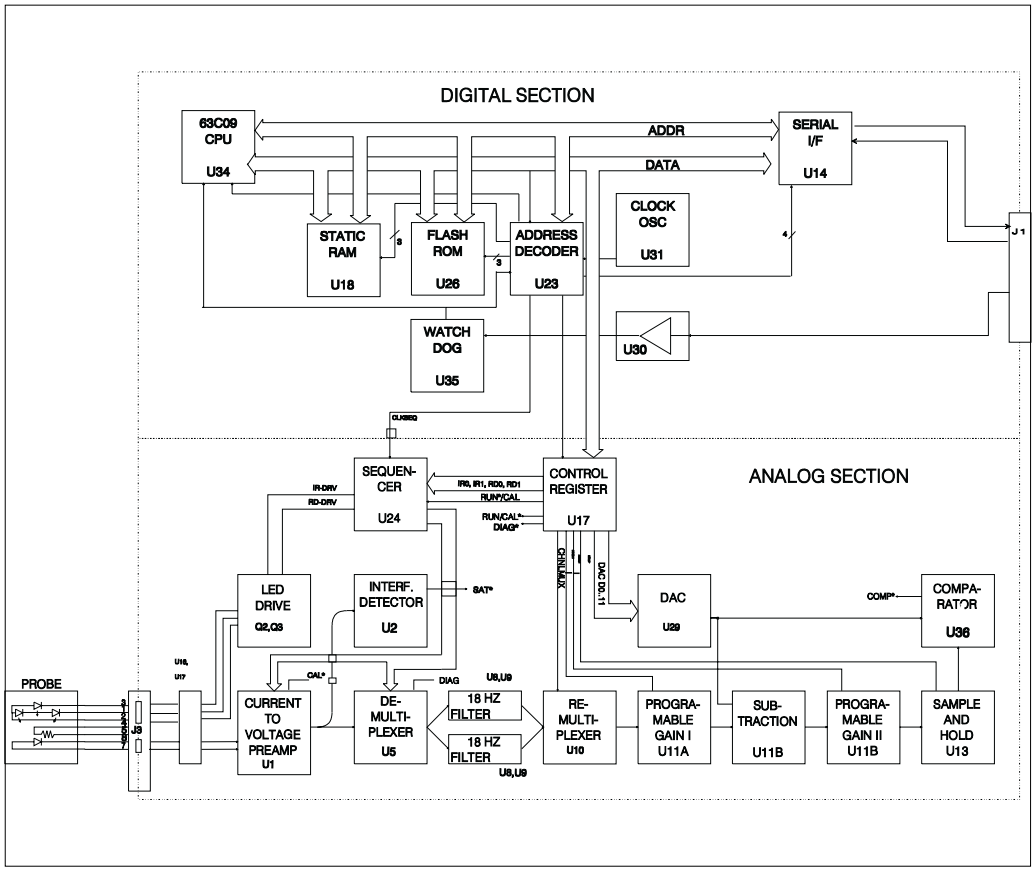


Figure 2-7

SpO_2 Block Diagram

2.2.6 Main Power Supply

Power supply for Sealed Lead Acid Battery

The power supply is capable of operation between 85 and 264 Vac, 47 to 63 Hz sinewave input source.

It is a fixed frequency, (62 Khz) flyback buck converter with a secondary buck and flyback converters for the outputs. The bulk output of about 17 V is regulated via opto-coupler feedback. The bulk supply has over voltage and over current protection.

The secondary battery connection is diode "or"-ed with the bulk supply in order to provide operation without AC applied. The battery is charged via a four stage charger.

Battery Charger for Sealed Lead Acid Battaery

The battery charger provides four levels of charge stages as well as over current and over voltage protection. The circuit is based on a single chip controller, the Unitrode UC3906, and external programming components. In this implementation, the circuit detects the presence and voltage of the battery and provides a very low current source to determine the state of the battery. If the battery voltage begins to rise, at a preset threshold, the circuit switches to a heavy charge rate until and upper charge level is attained. At this stage the circuit will switch into an overcharge or float charge mode to insure a fully charged battery.

Power Supply for Lithium Ion battery

The power supply is capable of operation between 85 and 264 vac, 47 to 63 Hz sinewave input source.

It is a fixed frequency, (62 Khz) flyback converter with individual secondary buck and flyback converters for the outputs. The bulk output of about 14.5 V is regulated via opto-coupler feedback. The bulk supply has over voltage and overload protection.

The output converters are diode "or" ed from either the bulk output of the battery output in order to provide operation without AC power applied.

Battery Charger for Lithium Ion battery

The battery charger provides a two phase fast charge algorithm for Li-Ion batteries. In phase one, the charger regulates constant current until the battery reaches the maximum cell voltage (MCV). The charger then moves to phase two, and regulates the battery voltage at MCV until the charging current falls to 14% of nominal. The charger then terminates until the battery voltage falls below 95% of MCV.

The charger monitors battery condition, battery temperature, charging time, as well as load on the outputs during battery charging operation. If the battery is severely depleted, the charger will trickle charge at a rate of 1 Hz until the battery is revived. The charger will suspend fast charge if the battery temperature is below 0 Deg C or above 45 Deg C. The charger will also suspend fast charge if the battery has not reached voltage regulation within its allotted time. If the Accutorr unit is operated during battery charger operation, then the maximum fast charge current will be reduced.

2.2.7 Communication Board

The Accutorr Plus Communication module provides the communication signal interface between the LED/CPU board, 0670-00-0650-01, and the external communication interface connectors. The board supports the CIS/HI/DIAP interface via RS-232E, provides a feed through path for the Datascope proprietary download connector, DC/DC converter for the +12 Vdc @ 100 mA required for wireless telemetry controlled by the CPU and includes the driver for an external isolation relay that is activated by Nurse Call (future option).

The RS-232E interface, used for DIAP, is implemented using a Maxim, MAX239 Multi-Channel Transceiver (U2). This chip has a minimum 10 volt output signal level, which provides a safe operating margin above the 5 volt minimum RS-232 operating signal level. Communications is to support a 5 wire interface, 4 signals and a ground. The signals are described below:

All RS-232 signal are ESD protected by a U3, an SM14M24C Transient Voltage Suppressor array. The +12 Vdc power required by the MAX239 is supplied from the on board DC/DC converter. In addition the MAX239 requires 5 Vdc for the internal logic. This is supplied as an input to the communications module. The MAX239 receivers are controlled by logic signal CSTAT*. Logic 0 enables the receivers, otherwise they are tri-stated.

The RS-232 signals appear on connector J2, a dual row 5 pin header which will have a mating 10 pin pendant ribbon cable attached. The other end of the ribbon cable assembly is a 9 pin panel mount `D' connector. Included on this connector are pins for the future Nurse Call option. See chart for pinout.

The Accutorr Plus software is upgradable via a three wire download communications interface. The required drivers are located on the LED/CPU board and only a signal path is provided to the external interface connector. ESD protection for the signal lines is provided by part of U3. Communications is to support a 3 wire interface, 2 signals and a ground. The signals are Tip being transmit, Ring is receive and shield is ground.

The on board DC/DC convertor provides +12VDC power required for wireless telemetry that will be a future feature available for Accutorr Plus as well as some local circuitry. The DC/DC converter is implemented using a Maxim MAX1771 DC/DC controller used in the Buck/Boost configuration. The supply is designed to deliver 12 Vdc @ 100 mA minimum. When the SHDN pin (U1-4) is high the MAX1771 enters the shutdown mode and its output is approximately zero volts. The shutdown mode is controlled by the state of either of two logic signals NCALL* or CSTAT*. If either of the signals is logic 0, the DC/DC converter will operate normally.

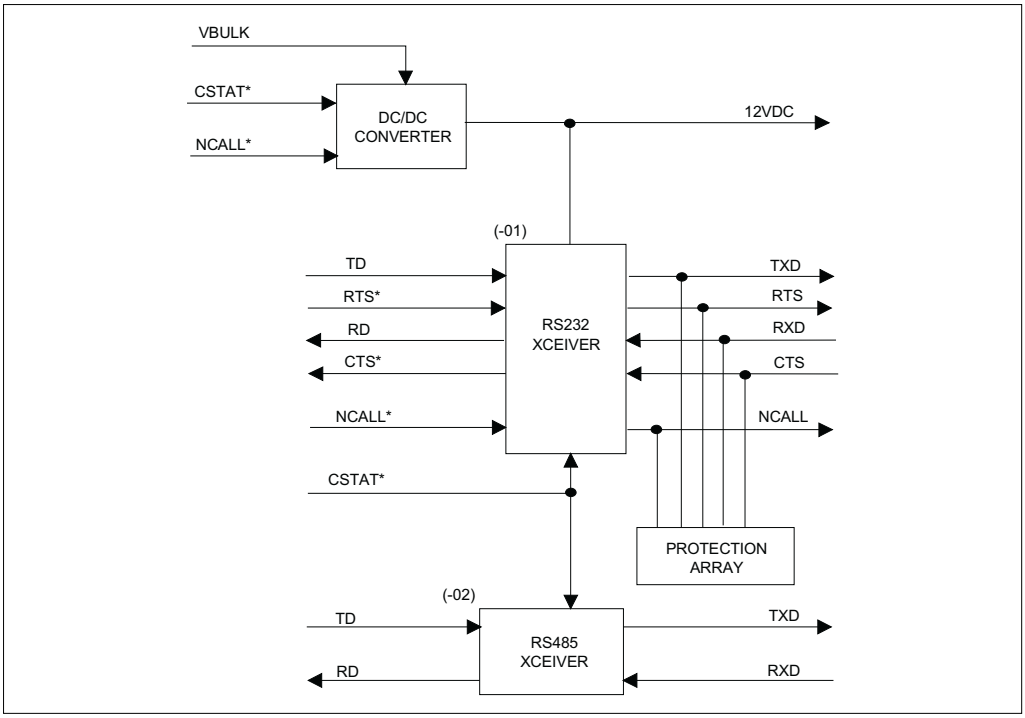


Figure 2-8

Communication Board Block Diagram

The pin assignments for the 9 pin `D' connector are as follows:

PIN	INPUT/OUTPUT	DESCRIPTION	NAME
1	Output	12VDC @ 100mA	TR_PWR
2	Input	RS-232	EXT_RXD
3	Output	RS-232	EXT_TXD
4	Output	10 Vdc min.	Nurse_call
5	Output	Ground	DGND
6	Output	Ground	DGND
7	Input	RS-232	EXT_RTS
8	Output	RS-232	EXT_CTS
9	Output	Ground	DGND

For Standard DIAP connection use pins 2,3,5,7&8 for 5 wire communication and use pins 2,3&5 for 3 wire communication. For connection to a PC the cabling must be Null Modem or:

Signal	Accutorr Plus Pin	PC pin
TXD	3	2
RXD	2	3
Ground	5	5
RTS	7	8
CTS	8	7

2.2.8 LCD Inverter Module - 0670-00-0649

This describes the circuit that will provide the 90 VAC required for the LCD Module back lite exitation.

DC to AC Inverter

The system +12V signal is fed into the module on J2-1. This signal is then fed to J1-1. The inverter is powered by +12SW (12.5 volt nominal) from J1-2.

Once powered, the inverter is designed to provide the AC waveform required by the backlight over the cabinet temperature range and +12V tolerance. The output AC waveform is 90 Vrms minimum voltage. The AC frequency is to be between 360Hz and 440Hz. C1 and C2 provide filtering of the inverter DC input.

Current Switch

The Q1 gate is connected to J2-3, ELOFF*. This control signal is pulled low by R1 which maintains Q1 in the off state if J2-3 is floating. Since Q1 passes the inverter return current to the ground signal PGND on J2-2, Q1 must be on to enable the inverter. The host can turn on Q1 and enable the T1 inverter by driving ELOFF* high. D1 filters switching transients on +12SW when Q1 is turned on and off.

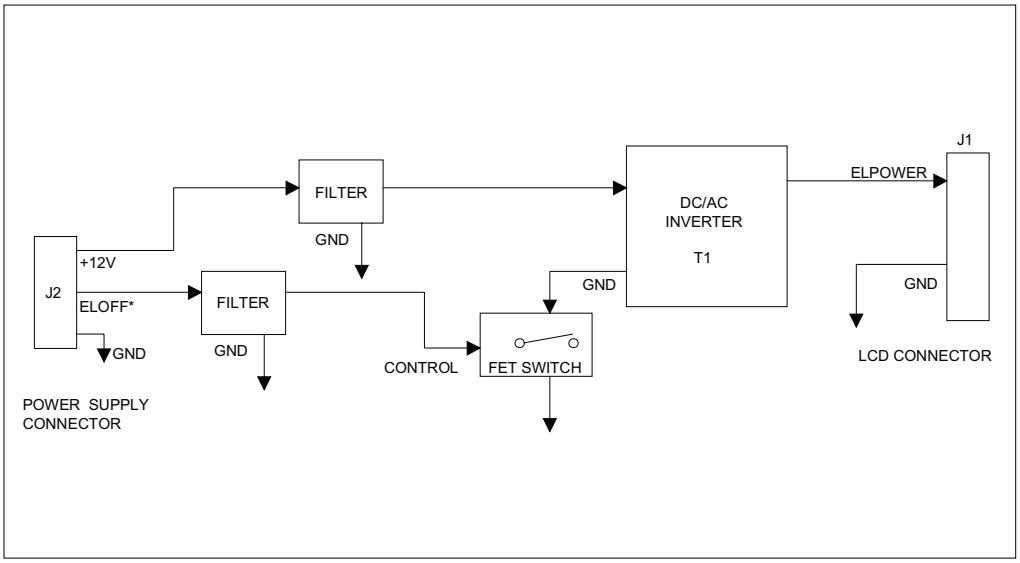


Figure 2-9

LCD Inverter Module Block Diagram

2.2.9 Nellcor® MP 304 SpO_2 Circuit Board Theory of Operation

The MP 304 is a complete SpO_2 detection and determination circuit, proprietary of Nellcor® Puritan Bennett.

The MP 304 is centralized around a Motorola MC68HC16 micro processor (U-4), driven by a 32.76 Khz. Oscillator. (Y-2) The processor is supported by a 32K x 8 static RAM (U-3) and a SpO_2 program boot EPROM (U-6).

Patient information is initially processed in a patented ASIC (U-1) (Application Specific Integrated Circuit). Clock pulses are provided by Y-1, a 10 MHZ oscillator. The resulting analog data is then routed into separate Red and Infra Red ADC's (Analog to Digital Converters) (U-5 and U-7) The resulting digital data is clocked into the microprocessor and is transmitted serially to the Nellcor® Interface Board (0670-00-0675) for further processing and display.

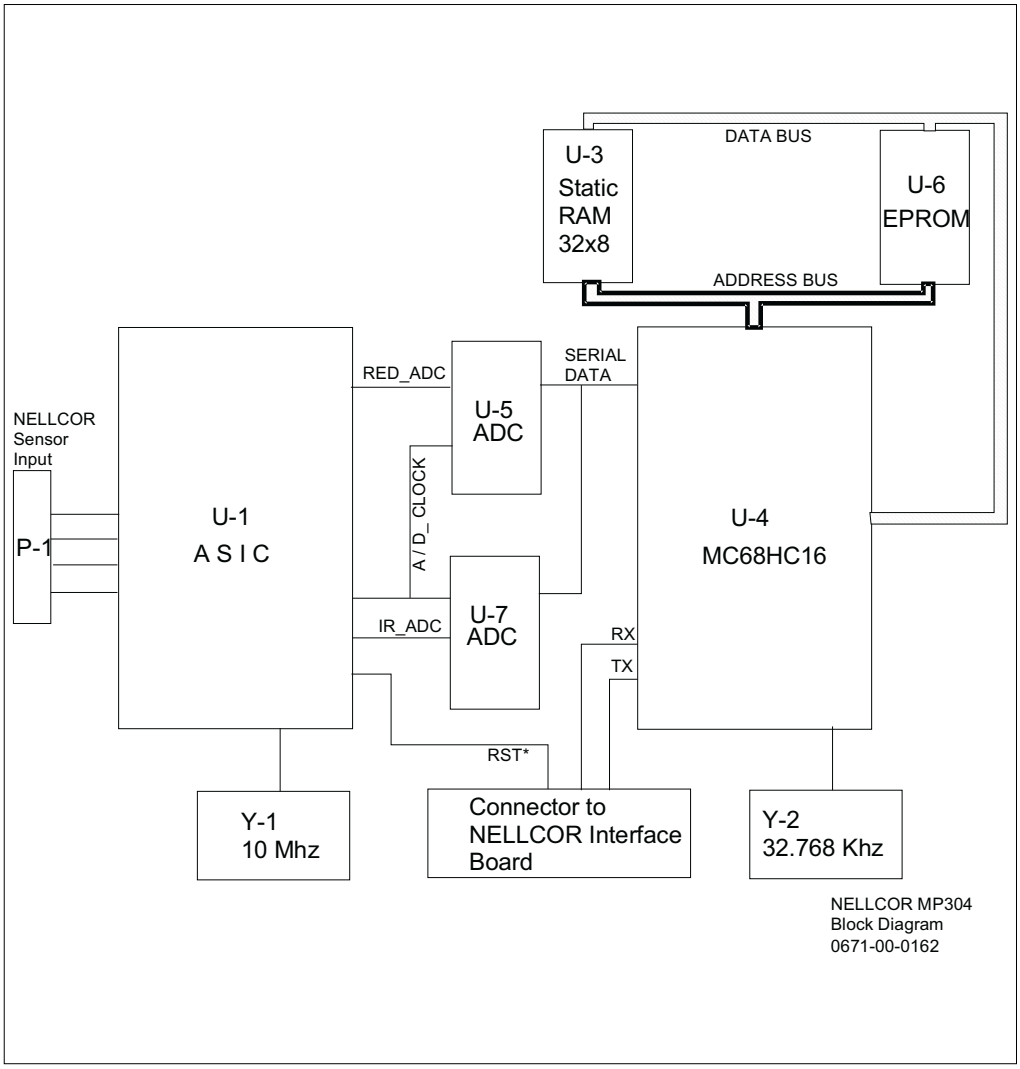


Figure 2-10

Nellcor MP304 Block Diagram

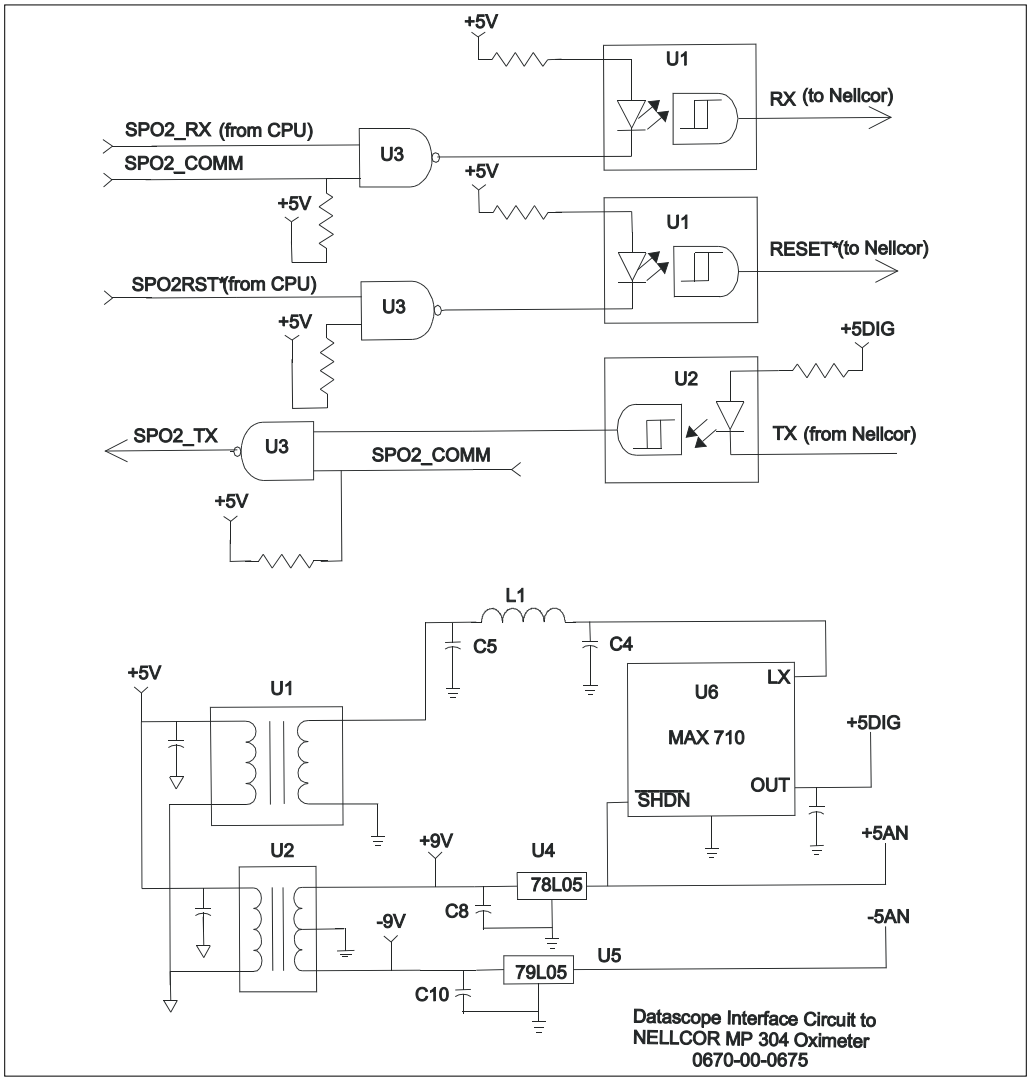
2.2.10 Nellcor® Interface Board Theory of Operation

The Datascope to Nellcor® interface circuit board establishes bi lateral communication and control of the Nellcor® Oximeter circuit board.

The circuit board consists of a power supply section that converts +5 VDC into the logic and analog supplies required by the oximeter, and optically isolated logic control for the processing circuits of the oximeter. The optically isolated up converter U1 convert the +5 VDC from the main power supply, into an input voltage for U6, of about 5 VDC. The precision down converter, U6, steps down and regulates the +5 VDC voltage for the digital sections of the oximeter circuit.

The optically isolated up converter U2 convert the +5 VDC to a bi polar +9 and -9 VDC input for U4 and U5, then regulated to +5 and -5 VDC.

The logic control section, consisting of U1, U2 and U3, provide the buffer and isolation functions from the main CPU circuit to the Nellcor® oximeter section.



Figur2-11

Datascope Interface Circuit to Nellcor MP304 Oximeter

2.2.11 Masimo SET® Technology

Masimo SET Technology, combines advances in fundamental sensor technology, digital signal processing, an easily portable platform and a low noise hardware platform incorporating multiple wavelengths applicable to many physiological parameters.

Masimo's SET Technology is composed of three components; (1) new signal processing apparatus, (2) a new method for *invivo* measurement, and (3) new sensor technologies. The main benefit of Masimo's technology is the effective cancellation of unpredictable "in-band noise" (noise which is in the same frequency, phase and/or amplitude space as the desired signal).

Conventional fixed filters, whether analog or digital form, have been designed to pass certain frequencies while rejecting others. For example, a bandpass filter with a lower cut-off frequency of 1hz and an upper cut-off frequency of 10Hz will pass all frequencies between 1hz and 10Hz and reject frequencies below 1hz and above 10Hz. Therefore, any "noise" that has a frequency outside the pass band is rejected and not considered (i.e. 120Hz due to room light and 60Hz noise from electrical lines). However, if noise exists between the pass band of 1hz and 10Hz it will enter the system with the desired signal and corrupt the measurement (i.e. patient motion at 2Hz). Fixed filters will always have this limitation.

Masimo has overcome these problems by developing a novel technique to accurately determine the noise reference (patents issued and pending); thus, making adaptive filters work in real-time even when applied to medical monitoring of widely variable and unpredictable patients. With this new technique, Masimo is able to solve the perennial problem of motion artifact in pulse oximetry.

Masimo licenses this technology to Datascope. Further technical information is available from Masimo on the Internet at www.Masimo.com.

2.2.12 Masimo Interface Board Theory of Operation

Introduction

The Accutorr Plus Masimo interface board (P/N: 0670-00-0716) provides an isolated data and power interface between the Accutorr Plus and the Masimo MP-3 Pulse Oximetry Module.

The patient isolation requirement for the Masimo section is 1500VAC, less than or equal to 1mA leakage current, from input connectors J1 and J4-all terminals to J2-all terminals.

The isolated DC/DC converter, T1, supplies the regulated+5DIG as required by the Masimo MS-3 Pulse Oximetry Module. The digital 5V is then utilized to generate the analog ±15V used by the MS-3. The optocouplers (U1 and U2) isolate the signals used for bidirectional serial communication with the Masimo MS-3 Pulse Oximetry Module. Control signal, SpO_2_COMM at J4 will allow the Accutorr Plus software to interrupt the serial transmission for future options. Future interface to the Display Controller board (at J3) will provide isolated ±9volts to the Front End

Theory of Operation

An overall block diagram of the interface board is shown in Figure 1 below. All data and control lines interfaced to the SpO_2 Module are opto isolated. Power to the SpO_2 Module is isolated by a DC/DC converter with the input coming directly from the CPU/LED Module.

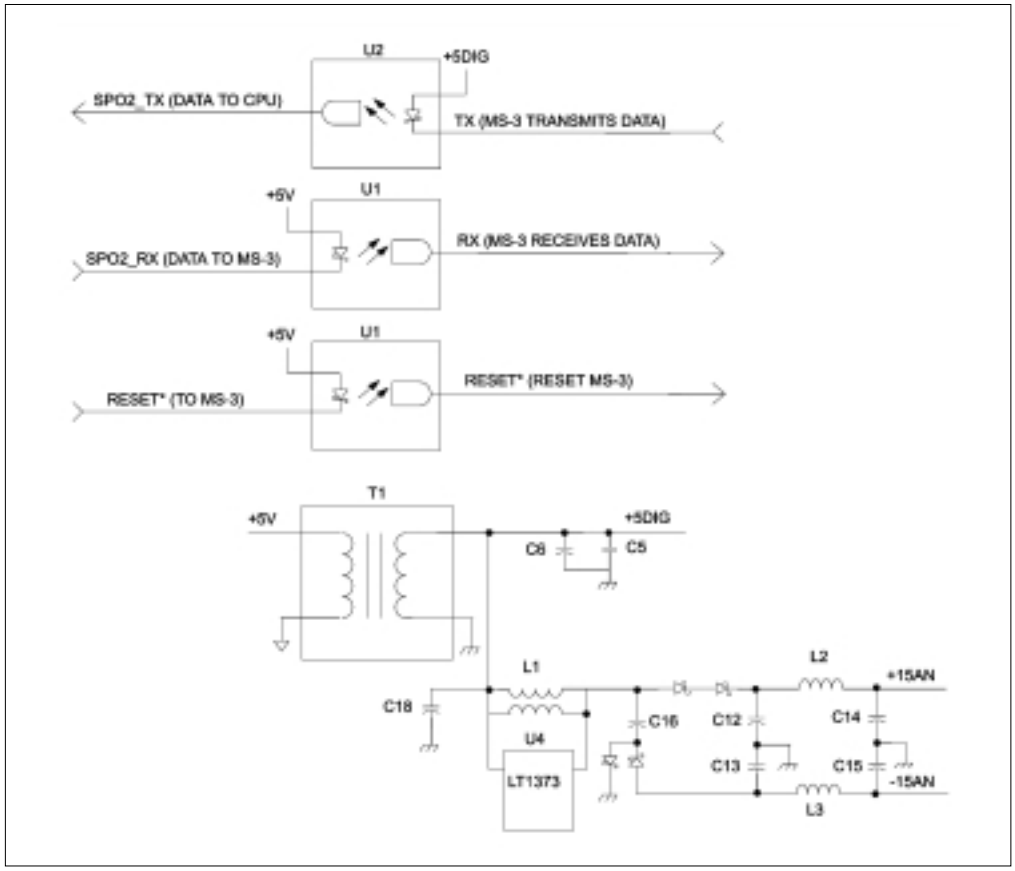


Figure 2-12

Detailed Description

It would be helpful to have a schematic (0387-00-0716) while reading the following circuit descriptions.

Power

The power for the interface board is supplied by the system +5V. It is used for the pull-up resistors (R1, R2 and R6) on the serial and control lines as well as the LED drive resistors (R3 and R4) on optocoupler U1. It is also the input to isolation converters T1 and T2. In addition, the system +5V is the supply voltage for optocoupler U2 and the logic gates in U3.

T1 converts the unisolated system +5V into an isolated and regulated source, +5DIG, for many uses. The converter provides suitable isolation to the specified patient limit of 1500VAC. The majority of the current from +5DIG is delivered to the MS-3 board. It also acts as the supply voltage for optocoupler U1 and the ESD protection array, U5. In addition, the digital voltage supplies the LED drive resistor (R5) on optocoupler U2.

The second largest usage for the +5DIG is as an input for the LT1373. The LT1373 is a high frequency current mode switching regulator running at approximately 250kHz. In this design, it is configured as an extremely efficient dual flyback converter. It will convert a single input voltage ranging from 2.7 to 25 volts into a positive and negative output. This design utilizes the feedback to provide +/-15VAN to the MS-3 board. The power transistor "switch" integral to the LT1373 alternately charges and discharges the output capacitor C16. C12 and C13 provide the hold-up time for the output voltages. L2-C14 and L3-C15 are additional low pass filters for the analog voltages.

Converter T2 generates an unregulated +/-9V (used for the front end). Schottky diodes CR1 and CR2 provide reverse polarity protection for T2. C10 and C11 filter the isolated +/-9V in order to reduce the ripple on each supply.

Caps C17 and C19 on the input of the two DC/DC converters are necessary to reduce the ripple reflected back on to the system +5V. This noise is generated due to the transient nature of the MS-3 loading.

Communication

The interface signals to and from the MS-3 are isolated (2500VAC) by two optocouplers, U1 and U2. The optocouplers include integrated Schmitt triggers at the outputs. This provides logic compatible waveforms without the need for external pull-up resistors. NANDs are used in the transmission lines to provide the necessary inversions for proper signal polarity and to force the optocouplers normally off. The low duty cycle of the signals also holds the power requirements to reasonable levels.

Communications with the SpO_2 Module take place by a CMOS level asynchronous serial link from J1. The parameters are 8 data bits, no parity, one stop bit, with the data having "true" polarity. The baud rate is fixed at 9600 bps.

Display Controller Connections

A four pin right angled connector (J4) is available to interface with the future Display Controller board. The serial information received (TX and RX) will be used to generate a pleth waveform. The control signal (SpO_2_COMM*) will be an active low signal used to enable a download to this future board.

Front End Connections

The front end section of the future Display Controller board will be provided with an unregulated +9V and –9V. These supplies will be able to sustain maximum loads of 56mA each (refer to the manufacturers data sheet for T2, CDI 109D5VFS).

2.2.13 Tone Processor Board Theory of Operation

The Accutorr Plus Tone-Processor module drives all alarms and advisory tones, generated by the LED/CPU module, to the speaker. The signal is passed through a DAC (Digital-to-Analog-Converter), which controls the rise and decay of the output tone to comply with EN-475 specification

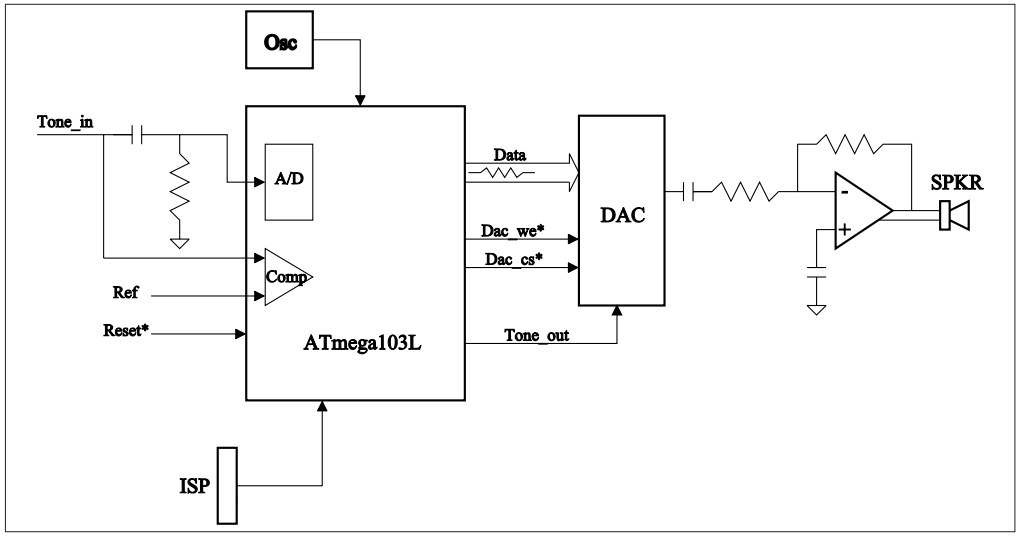


Figure 2-13

Tone-Processor Module Functional Block Diagram

Device U1 is an Atmel ATmega103, 8-bit AVR microcontroller. The ATmega103 is a low-power CMOS microcontroller based on the AVR RISC architecture. Its throughput approaches one MIPS per MHz allowing optimization of power consumption versus processing speed.

U2 is a dual 8-bit DAC that interfaces to the Microcontroller. It controls the tone up/down ramping under the command of the Microcontroller, by controlling the attenuation to its input signal. The device's chip-select and write-enable pulses are provided by the Microcontroller.

Proper hardware operation places specific requirements on the module's software. Although specific implementation details fall beyond the scope this document, the following is an overview of the major tasks to be performed by the software.

The Microcontroller would normally be placed in a sleep state, after initialization, in the absence of a tone signal in order to conserve power. Upon the presence of an advisory tone or an alarm an interrupt is generated, which wakes up the device. The amplitude and frequency of the incoming signal is analyzed then, a replica of the input signal is generated, after approximately 25ms delay, and presented to the DAC. The tone ramp-up sequence is accomplished with dedicated I/O ports, which drives write commands and control bytes with an increasing count and to the DAC, triggered by the period of the input tone. This would result in an audible tone with rising amplitude. Upon detection of the end of the tone burst, the ramp-down sequence is entered, similar in nature to the ramp-up sequence.

3.0 SPECIFICATIONS

CONTENTS OF THIS CHAPTER . . . . . Page

3.1 PERFORMANCE SPECIFICATIONS

Systolic Pressure Readout

Number of Digits:	3
Accuracy*:	Mean error less than 5 mmHg, Standard deviation less than 8 mmHg.
Range:	Adult Mode: 55 to 260 mmHg Pediatric Mode: 55 to 160 mmHg Neonatal Mode: 45to 120 mmHg

Diastolic Pressure Readout

Number of Digits:	3
Accuracy*:	Mean error less than 5 mmHg, Standard deviation less than 8 mmHg.
Range:	Adult Mode: 30 to 200 mmHg Pediatric Mode: 30 to 150 mmHg Neonatal Mode: 25 to 100 mmHg

**Tested per ANSI/AAMI SP10-1992 methods.*

NIBP Measurement Cycle Time

Less than 30 seconds average at 80 BPM with 180mmHg pump up pressure, without retries, motion artifact or arrhythmia with standard adult cuff on a healthy individual. Cycle time is affected by arm size and wrapping technique.

Pulse Rate

Range:	35-245 BPM for Adult and Pediatric 70-245 BPM for Neonate
Display Resolution:	1 BPM
Accuracy:	3 BPM or 3%, whichever is greater

Maximum Cuff Pressure

Two means of limiting cuff pressure are provided; a hardware over pressure monitor which limits the pressure to 330mmHg for Adults, 220mmHg for Pediatrics and 165mmHg for Neonates. A software overpressure monitor which vents if the pressure exceeds 300mmHg for Adults and 200mmHg for Pediatrics. If the hardware over pressure circuit is tripped in normal operation then the unit must be turned off and back on to reset the system.

Inflation Source

This inflation source is capable of supplying sufficient air to bring a volume of 700cc's to a pressure of 300 mmHg in no more than 35 seconds. If the cuff is not inflated to the desired pressure within 60 seconds then the cuff is vented and a retry cycle is initiated.

Leak Rate

With the bleed valve closed, the maximum pressure drop shall be 10 mmHg in 90 seconds measured with a 700cc volume at a differential pressure of 250 mmHg.

Cuff Vent Rate

When the unit is vented, a volume of at least 700 cc's is reduced from a pressure of 250 mmHg to a pressure of 20 mmHg in a maximum of 14 seconds.

Temperature (Predictive)

Range:	90-110 F, 32-43 C
Display Resolution:	0.1 F, 0.1 C
Accuracy:	Meets ASTM E1112-86 for accuracy.

Datascope SpO_2

Range:	40-100% SpO_2
Display Resolution:	1% SpO_2
Display Update:	Less than 4 seconds
Calibration:	Factory Calibrated to Functional Saturation
Accuracy - Datascope:	2% from 70 - 100% SpO_2 4% from 60 - 69% SpO_2 unspecified from 40-59% SpO_2
Pulse Rate Range	30 to 250 BPM
Pulse Rate Accuracy	±3 BPM or 3% of the reading, whichever is greater.

Nellcor® SpO_2

Range:	40-100% SpO2
Display Resolution:	1% SpO_2
Display Update:	Less than 4 seconds
Calibration:	Automatic
Accuracy - Nellcor®:	2 digits from 70 - 100% SpO_2 - Adult 3 digits from 70 - 100% SpO_2 - Neonates unspecified from 40-69% SpO_2
Pulse Rate Range	21 to 249 BPM
Pulse Rate Accuracy	±3 BPM.

Neonatal accuracy specifications are based upon testing the N-3000 and N-25 neonatal sensors on healthy adult volunteers in induced hypoxia studies, in the range of 70-100% SpO_2. The specified accuracy also takes into account published literature which predicts that there may be a small difference in % SpO_2 reported by the oximeter when measurements from adult and fetal blood with 100% fetal hemoglobin are compared. Fetal hemoglobin is present in concentrations varying from 10% to 90% in neonatal blood, and this percentage declines over time. As the percentage of fetal hemoglobin in neonatal blood declines, the theoretical effect on accuracy due to this source is reduced".

Masimo® SpO_2

Range:	40-100% SpO_2
Display Resolution:	1% SpO_2
Display Update:	Less than 4 seconds
Calibration:	Automatic

SpO_2 Accuracy Saturation during No Motion Conditions[1]:

Adults:	70% to 100% 2 digits
Neonates:	70% to 100% 3 digits 40 to 69% SpO_2 unspecified.

SpO_2 Accuracy Saturation during Motion Conditions:[2]

Adults:	70% to 100% 3 digits
Neonates:	70% to 100% 4 digits
Pulse Rate Range:	26 to 239 BPM
Pulse Rate Accuracy:	±3 BPM

[1]The Masimo MS-3 pulse oximeter with LNOP Adt sensors have been validated for no motion accuracy in human blood studies on healthy adult volunteers in induced hypoxia studies in the range of 70% to 100% SpO_2 against a laboratory co-oximeter and ECG monitor. This variation equals plus or minus one standard deviation. Plus or minus one standard deviation encompasses 68% of the population.

[2]The Masimo MS-3 pulse oximeter with LNOP Adt sensors has been validated for motion accuracy in human blood studies on healthy adult volunteers in induced hypoxia studies while performing rubbing and tapping motions at 2 to 4 Hz. At an amplitude of 1 to 2 cm and non-repetitive motion between 1 to 5 Hz. At an amplitude of 2 to 3 cm in induced hypoxia studies in the range of 70% to 100% SpO_2 against a laboratory co-oximeter and ECG monitor. This variation equals plus or minus one standard deviation. Plus or minus one standard deviation encompasses 68% of the population.

Battery

Battery Type:	Sealed Lead Acid	Lithium-ion
Number of Batteries:	1	1
Battery Voltage:	12 VDC nominal	10.8 VDC nominal
Battery Capacity:	2.3 Amp-Hour	3.6 Amp-Hour
Battery Run Times from full charge with a new battery at 25° C with 1 NIBP measurement every 5 minutes and recorder in use.	Accutorr Plus NIBP – 5 Hour	Accutorr Plus NIBP – 8 Hours
	Accutorr Plus NIBP with Trend Screen – 3 Hours	Accutorr Plus NIBP with with Trend Screen – 8 Hours
	Accutorr Plus NIBP with Trend Screen and SpO2: Datascope – 1.5 Hours Nellcor – 2 Hours Masimo – 2 Hours	Accutorr Plus NIBP with Trend Screen and SpO2: Datascope – 3.5 Hours Nellcor – 4.5 Hours Masimo – 4.5 Hours
Recharge Time:	8 hours max., in standby only	2 hours max., in standby only
Cyclic Service Life:	150 cycles, 100% to 20% of capacity	500 cycles, 100% to 30% of capacity
	400 cycles, 100% to 40% of capacity	1000 cycles, 100% to 50% of capacity

Real Time Clock

Resolution:	1 minute
Accuracy:	1 minute/week
Display Format:	24 hours
Power:	The real time clock maintains the time and date when the instrument is On or in the Standby mode, connected to AC mains or running from internal battery for at least ten years from original assembly. The real time clock will maintain time and date even if the instrument's main battery is disconnected.

3.2 Safety Characteristics

Risk (Leakage) Currents

Enclosure Risk Current (leakage):	Less than or equal to 100*u*A in normal operating conditions. Less than or equal to 300 *u*A in any single fault condition .
Patient Source Current:	Less than or equal to 10*u*A in normal operating conditions. Less than or equal to 50*u*A in any single fault condition.
Patient Sink Current:	Less than or equal to 50*u*A.

Dielectric Withstand

2500V RMS at 50 or 60 Hz for 1 minute from any patient lead or combination of patient leads to the chassis.

1500V RMS at 50 or 60 Hz for 1 minute AC mains hot or neutral to the chassis.

Ground Resistance

Ground resistance less than or equal to 0.1 ohm from the AC mains power inlet module's ground contact pin to any exposed metal part which may become energized when measured per UL-544 and IEC 601-1. A ground resistance of up to 0.2 ohm is allowed when measured from the U blade of the supplied AC line cord to any exposed metal part which may become energized.

Type of Protection Against Electric Shock

Class 1 with internal electric power source. Where the integrity of the external protective earth (ground) in the installation or it's conductors is in doubt, the equipment shall be operated from it's internal electric power source.

Degree of Protection Against Electric Shock

Monitor – Type B applied part.
NIBP – Type BF defibrillation protected applied part.
SpO_2 – Type BF defibrillation protected applied part.

Protection Against Hazards of Explosion

Not protected (ordinary).

Protection Against Ingress of Liquids

Not protected (ordinary).

3.3 Physical Characteristics

Size (maximum):

Main Unit:	19 cm(W) x 26.93 cm(H) x 20.83 cm (D) 7.5" (W) x 10.6" (H) x 8.2" (D)
Recorder Module:	5.33 cm(W) x 23 cm(H) x 11 cm (D) 2.1" (W) x 9" (H) x 4.25" (D)
Predictive Module:	5.7 cm(W) x 15.9 cm(H) x 11.8 cm (D) 2.25" (W) x 6.25" (H) x 4.63" (D)
Weight:	<4.95 kg (11 pounds), depending on configuration.

3.4 Environmental Characteristics

Operating Temperature:	
Accutorr Plus with or without Recorder:	10 C to 40 C, (50 F to 104 F)
Infrared Therrmometer Module:	18 C to 40 C, (65 F to 104 F
Predictive Thermometer Module:	10 C to 32 C, (50 F to 90 F)
Operating Humidity:	15 to 90% max, non-condensing.
Shock and Vibration:	Meets IEC 68-2-27, IEC 68-2-37.
Shipping:	Meets ISTA Test Procedure 1A (less than 100 lbs.)
Storage Temperature:	-15 C to +40 C, +5 F to 104 F
Storage Humidity:	10 to 95%, non-condensing.
Operating Altitude:	1013 hPa to 782 hPa (0 to 7,000 ft.). for units with an LCD 1013 hPa to 697 hPa (0 to 10,000 ft.) for units without an LCD

3.5 Electrical Ratings

Voltage:	100 - 120 / 220 - 240 VAC
Current:	0.6 / 0.3 A
Frequency:	60 / 50 Hz
Power Consumption:	40 W, maximum

3.6 Agency Compliance

The Accutorr Plus is designed to comply with the following agency standards:

EN 60601-1:1990	Medical Electrical Equipment – General Requirements for Safety
UL 2601-1:1994	CSA C22.2, No. 601.1-M90
EN 475 : 1995	Medical Devices Electrically Generated Alarm Signals
ISO 9919:1992 (High End units only)	Pulse Oximeters for Medical Use – Requirements
EN 60601-2-30:1995	Particular requirements for the safety of automatic cycling indirect blood pressure monitoring equipment
IEC 60601-1-2:2001	Particular requirements for safety (EMC)

EMC Requirements per FDA 510K Reviewers Guide, Section m.7.ii for
- Steady-State voltage
- Dropout
- Slow Sags and Surges
- Quasi-Static Field Susceptibility

3.7 ELECTROMAGNETIC COMPATIBILITY

The Accutorr Plus has been tested and found to comply with the requirements of IEC 60601-1-2: 2001 "Collateral Standard Electromagnetic Compatibility Requirements and Tests."

To ensure Electromagnetic Compatibility (EMC), operate the Accutorr Plus in accordance with the instructions for use.

To prevent the possibility of other equipment affecting the Accutorr Plus, insure adequate distances are maintained between devices.

4.0 REPAIR INFORMATION

CONTENTS OF THIS CHAPTER . . . . . **Page**

4.1 INTRODUCTION

This chapter of the Service Manual provides the technical information necessary to resolve most instrument malfunctions. Important prerequisites for effective troubleshooting are a thorough understanding of the instrument functions, and specification, as well as an understanding of the theory of operation. Refer to Chapters 1, 2, and 3 of this manual for detailed information.

Functional over views of the major circuit blocks are provided in the Theory of Operation, Chapter 2, of this manual, for those technically qualified who may prefer to isolate problems to a sub-circuit or component level. Component level repair activity is not always possible. Isolation of defective components is frequently impossible without the functional emulation of operating software. The equipment and processes required are not cost effective on a single unit basis.

This procedure is for the use of qualified technical personnel only. Datascope Corp. offers a comprehensive selection of Technical Training Seminars for this and other products. Contact the Registrar, Technical Support Department or your regional sales or service representative for course offerings and dates.

4.2 SAFETY PRECAUTIONS

There are areas where improper repair techniques will cause further damage. When the instrument covers are removed, observe the following precautions and guidelines.

1. Power line voltages will be exposed; identify hazard points and avoid direct contact.

2. Battery terminals are accessible; do not short to each other or the positive terminal to ground circuits, as the capacity of the battery is sufficient to create an over heating safety hazard.

3. Fuses must not be by passed or replaced by different current, voltage or time delay ratings.

4. The circuit boards contain static sensitive components; use proper static safeguard techniques.

CAUTION: *Li-Ion batteries are intended for replacement by qualified service personnel only.*

CAUTION: *Li-Ion batteries used in this device may present a risk of fire or chemical burn if mistreated. Do not disassemble, heat above 100°C (212°F), or incinerate. Replace battery with Datascope P/N: 0146-00-0069 only. Use of another battery may present a risk of fire or explosion.*

CAUTION: *Dispose of used battery promptly. Keep away from children. Do not disassemble and do not dispose of in fire.*

4.3 GENERAL TROUBLESHOOTING GUIDELINES

This procedure does not cover all possible problems. The intent of troubleshooting is to provide quick isolation and remedy of malfunctions and to return the instrument promptly to safe patient care. A logical approach will quickly identify the problem and suggest cost effective solutions.

Troubleshooting Tips

1. Isolate the cause of the problem to be either clinical, instrument or external.
   If a clinical cause is suspected, take the physiological measurement by a manual method or use an alternate measuring device. Check the physiological value against the instrument specifications; if exceeds specification, continue with manual or alternate method.

   If a problem with the instrument is suspected, first examine and / or replace patient connected accessories. Check instrument set-up / configuration. Ensure the correct battery charge profile is selected for the installed battery. If all set-ups are OK, replace instrument with similar device.

   If the environment is suspected, observe if the malfunction coincides with other equipment cycling (especially high power motors, RF generators, etc...). Replace problem instrument with an identical substitute. Place the problem instrument in a low disturbance environment. If the problem persists in the low disturbance environment, the instrument performance may be suspect. If the substitute instrument exhibits similar poor performance in the original environment, the environmental causes must be eliminated.

2. Use the proper equipment. Special test equipment required for problem isolation and resolution is listed in section 4.4. Similar devices may be used if they equal or exceed performance standards of the equipment suggested.

   PRECAUTION: *This instrument utilizes multiple layer circuit boards and laser and ultra sonic welded surface mounted components. Do not attempt to un-solder welded components from the circuit board; the circuit board will be permanently damaged.*

   PRECAUTION: *Soldering and solder removal equipment must be low voltage operated and grounded to avoid static charge and stray current induced component damage. Maximum wattage: 25 W.*

3. Clean the repair area. After soldering operations, clean off the repaired area with ethyl or methyl alcohol and a stiff hair brush. This will remove residual solder flux, making the repaired area more visible for an inspection and returning the instrument to its original, neat appearance. Removal of the flux will also facilitate making electrical measurements in the affected area as the flux itself is not conductive.

Exchange Program

Datascope offers a comprehensive circuit board and electro-mechanical module exchange program. The exchange circuits and modules are warranted, factory pre-tested and calibrated. Final calibration of the exchange item is strongly suggested to match the new part to the host system. See section 6.4 for details concerning the exchange program.

4.4 TEST EQUIPMENT REQUIRED

Equipment types other than these listed may be utilized if they equal or exceed the listed equipment performance.

- Dynatech Nevada Non-invasive Blood Pressure Simulator (Cuff Link)
- Power Supply, Power-Mate, 3A 20V
- Fluke D.V.M, Model 8050A
- Digital Storage Scope, Tektronix, 2230 100 MHZ
- Stop Watch, Wilson LW#119
- SpO_2 Simulator, Biotek Index, Smart SAT (All SpO_2 versions); N-1290 (Nellcor SpO_2 Only)
- RS232 Test Connector (Pins 2 and 3 Shorted)
- 700cc Dummy Cuff, Datascope #0138-00-0001-01
- Chart Paper, Datascope #0683-00-0447-01
- Water Bath, Cole-Palmer model H-12-105-10
- Reference Quartz Thermometer, Hewlet-Packard model HP-2804A with Temp. Probe HP-1811A

4.5 TROUBLESHOOTING (PROBLEM ISOLATION)

This section has been divided into two major areas; clinical and technical. Clinical problems can generally be resolved by the user. Technical problems may require resolution by a qualified technical service person. The error code table below indicates Technical problems with an asterisk (*). Error codes are displayed on the front panel LED's of the Accutorr Plus.

TYPE	CODE	DESCRIPTION	REASON
NIBP	8810	Retry - Unable to Measure	Motion artifact, cycle time-out, weak pulsations or no pulsations. A triple beep tone is generated.
	8811	Retry - Pump Higher	Insufficient cuff pressure. A triple beep tone is generated.
	8812	Stop - Cuff Overpressure	Excessive cuff pressure detected by the software. A triple beep tone is generated.
	8813	Stop - Unable to Measure	4 successive measurement attempts failed. A triple beep tone is generated.
TEMP (PTM)	8830	Check Probe	Tissue contact may have been lost.
	8831	Replace Probe	Defective probe or connection.
	8832	Battery Low	The 9V battery needs replacement.
SpO_2	8850	No Sensor	No sensor connected.
	8851	Sensor Off	Sensor not on patient. (Datascope and Masimo SpO_2 only)
	8852	Interference	Interference on signal. (Datascope and Masimo SpO_2 only)
	8853	Pulse Search	Unit cannot find signal. (Nellcor SpO_2 Module will report "Pulse Search" -8853- when the sensor is not on the patient.)
	8854	Weak Pulse	Weak pulse detected. (Datascope and Masimo SpO_2 only)
	8855	No Pulse	No pulse detected. (Datascope SpO_2 only)
	8856	Check Sensor	Sensor problem. (Datascope and Masimo SpO_2 only)
	8857	PR<30	Pulse rate is less than 30 bpm. (Datascope SpO_2 only)
	8857	PR<21	Pulse rate is less than 21 bpm. (Nellcor SpO_2 only)
	8857	PR<26	Pulse rate is less than 26 bpm. (Masimo SpO_2 only)
	8858	PR>249	Pulse rate is greater than 249 bpm. (Nellcor SpO_2 only)
	8858	PR>239	Pulse rate is greater than 239 bpm. (Masimo SpO_2 only)
	8858	PR>250	Pulse rate is greater than 250 bpm. (Datascope SpO_2 only)
SYSTEM	984*	NIBP Hardware Failure	NIBP A/D failure detected.
	985*	NIBP Overpressure Circuit not Programmed	The overpressure circuit is not set to the current patient size.
	986*	NIBP Overpressure Circuit not Tracking	The two pressure transducers are not tracking each other.
	987*	Stop - Hardware Overpressure	Excessive cuff pressure detected by hardware over-pressure sensor. A triple beep tone is generated.
	988*	TEMP Bad Calibration	Thermometer needs calibration.
	990*	TEMP Illegal Mode	Thermometer switch is set wrong.
	991*	TEMP Module Failed	Thermometer internal failure.
	995*	SpO_2 Uncalibrated	SpO_2 fails calibration check.
	996*	SpO_2 Failure	SpO_2 failed self-test.

Table 4-1 Error Codes

4.5.1 Isolating the Problem, System Level

1. Determine if the problem is in the main NIBP unit or one of the add on accessories.

2. If the problem is in the accessory, replace the 9 Volt battery in the temperature module, and check the recorder unit for correct paper, correct installation and paper jams.

3. If the problem is in the main NIBP and/or SpO_2 section, rule out these simple problems first:

   If AC power is available, then the green LED adjacent to the front panel On/Off keys should be illuminated. If not, connect the power cord to live power outlet. If green LED fails to illuminate, there is a probable power supply malfunction.

   Check the battery operation LED. Steady ON indicates battery operation. A flashing LED indicates a near depleted battery. If the green LED is NOT On, then the battery or power supply/charger may be suspect.

   Confirm correct operating parameters selection, i.e., correct patient size selection, (Adult, Neonate, Ped.) and NIBP cuffs to match. In units with SpO_2, verify that a sensor is connected to the unit and it is of the proper type/size. Verify the proper battery charge profile is selected for the installed battery.

4.5.2 Isolating the Problem within the Main Unit

Problems within the main NIBP and/or SpO_2 unit are categorized broadly into power supply problems and NIBP and/or SpO_2 detection and display. For a monitor that will not even turn on, proceed to Power Supply and Battery Tests, otherwise skip to Diagnostics Test and beyond.

1. Power Supply and Battery test: The main power supply output voltages should be verified under normal instrument loads. Voltages are shown on the System Block diagram, which is located in chapter 2 of this manual. Below are the tolerances for the voltages shown:
   5V = 4.9 - 5.1
   12.5V = 12 - 13
   15V = 14.5 - 15.5

2. Perform Diagnostics Test 01 through 12 . Repair or replace circuits or components that fail to pass the Diagnostic Test.

3. Trend circuits test: Obtain a minimum of five NIBP measurements and simultaneous SpO_2 and Temperature readings if the Accutorr has those options. Confirm Trend storage function as explained in sections 1.3.6, To View and Deleted Stored Data (Trend Mode) and 1.3.12, Recorder.

4.5.3 Isolating the Problems with Optional Accessory Modules:

1. Predictive Temperature Module Test: Obtain one or more temperature readings from the optional temperature modules. They will be displayed in the temperature display window. If the readings are not displayed, replace the temperature probe first, then the complete module.

2. Infrared (Accutemp I.R.) temperature module test: The following paragraphs will assist you to separate those clinical issues that can result in inaccurate or inconsistent readings, as well as instrument malfunctions.

   Since there are no user serviceable components (except 9V battery) inside the Accutemp I.R. all service requests should be directed to the factory.

3. Recorder Module Test: Obtain a print out of stored data, or perform diagnostics test (#4) to verify printer integrity. Substitute printer with a know good device to confirm diagnosis.

4.5.4 Clinical Issues

4.5.4.1 Multiple Temperature Measurements

The AccuTemp employs an easy and quick method to taking temperature measurements. Because of this it is tempting to take immediate, repetive measurements. However, taking immediate repetitive measurements in the same ear, may result in a decrease in temperature. This is because the probe of an ear thermometer is cooler than the ear canal and will draw the heat from the ear canal, cooling the canal slightly. Waiting a few minutes before taking another temperature in the same ear will give the ear canal time to recover, and the readings should be consistent with the initial measurement.

4.5.4.2 How the AccuTemp Measures Arterial Temperature (adults/pediatrics)

The AccuTemp is a self-calibrating infrared ear thermometer that accurately measures the infrared heat energy radiating from the ear canal opening. The AccuTemp determines the highest temperature in the ear canal opening, measures the ambient temperature, and then calculates arterial (core) temperature through its patented heat balance system. This measurement will respond instantly to changes in arterial temperature without the delays and artifacts inherent in oral and rectal methods, providing the means to identify a fever faster and more reliably than other methods.

Temperature gradients in the ear canal vary with the amount of environmental exposure, perfusion patterns, ambient temperature, etc. The least variable and therefore most accurate is the small deep area of warmest, but still visible tissue. A conventional ear thermometer takes many readings of the same large area, which includes the high gradient distal ear tissue, resulting in low, non-reproducible, and inaccurate temperature readings. The AccuTemp utilizes a narrow field-of-view and scanning capability to search the ear for the small deep area of warmest tissue required for heat balance calculation to ensure highly accurate and reproducible arterial temperatures.

The temperature measurement will remain on the display for a minimum of 55 and a maximum of 65 seconds after the Start button is released. If using the AccuTemp with and Accutorr Plus, the temperature measurement can be transferred from the AccuTemp to the Accutorr Plus for display and entry in to the trend database, by placing the AccuTemp in its holder within the 60 seconds after releasing the Start button. A beep tone is sounded from the Accutorr Plus once the temperature measurement information

has been received by the Accutorr Plus. NOTE: Do not change Room Number and /or Bed Letter on the Accutorr Plus during the transmission of temperature data.

The AccuTemp can be used to take temperature measurements for up to 128 power cycles without having to be put back into its holder. After 128 power cycles, the AccuTemp must be put back into the holder to be reset. When the 129th power cycle is reached and the Start button is pressed, 4 L's are displayed, indicating that the AccuTemp is locked and must be returned to its holder.

NOTE: The AccuTemp thermometer should be at room temperature when it is used. If it has been in a very warm or very cold environment it may need time for the thermometer temperature to equalize to ambient temperature.

4.5.4.3 Troubleshooting

The following table provides suggestions to resolve problems when taking temperature measurements:

Symptom	Suggestion
Various readings when taking measurements in the same location, ear or axilla.	Quick repetitive measurements in the same location can result in a decrease in temperature. This can occur because the optical head of AccuTemp may slightly cool the area. Wait a few minutes for the temperature of the area to equilibrate. Replace cover and clean lens. See section 3.3, Maintenance, for details on lens cleaning.
Various readings when taking measurements in opposite ears.	The patient may by lying down on one ear. The measurement of the ear that was down may be a higher temperature. Wait a few minutes for the temperature of the ear canal to equilibrate. This is also a factor if the area has been covered for any reason, i.e., hat, blanket, bandage, telephone, etc.
No measurement or inaccurate measurements.	This can be caused by technique errors: -Not keeping the button pressed throughout the measurement. -Not scanning side-to-side (adults and pediatrics). -Twisting or rotating the probe instead of scanning side-to side. -Not changing the protective optical film cover with each reading. (Even on the same patient.) -Debris on the lens. -Not covering the opening of the ear canal. -Presence of a visible wax plug, or dense hair blocking the view into the ear canal. -This can also be caused by low battery voltage.

AccuTemp Error	Reason
AccuTemp double beeps and displays "——" while holding the Start button. The AccuTemp then powers down.	Battery voltage < 5.7 VDC. Battery requires replacement.
AccuTemp double beeps while holding the Start button	Low battery condition. Battery voltage is between 6.2 and 5.7 VDC.
AccuTemp displays "E-O0"or "E-o1" while holding the Start button.	Return AccuTemp for service.

4.5.4.4 Maintenance

The AccuTemp can be wiped down with any hospital approved disinfectant, including bleach. With normal use, the only maintenance required is to keep the lens on the end of the probe clean. The lens is made of polycarbonate. Dirt, greasy films or moisture on the lens will interfere with the passage of infrared heat and affect the accuracy of the measurement. If necessary, clean the lens with a cotton swab dipped in alcohol. Periodic cleaning is recommended. To keep the lens clean when not is use, store the AccuTemp with an optical film cover in place.

4.6 DISASSEMBLY INSTRUCTIONS

PRECAUTION: THE INSIDE OF THIS INSTRUMENT CONTAINS STATIC SENSITIVE COMPONENTS. Use correct static protection safeguards.

NOTE: The numbers in parentheses ( ) refer to the isometric drawings (page 6-4). Before disassembling the unit, perform the following:

1. Power down the Accutorr Plus and remove the AC power cable.

2. Remove all cables and hoses from the front and rear of the instrument.

3. Remove temperature measuring module and recorder module, if equipped.

4.6.1 Removal of the Rear Housing (27)

1. Place the Accutorr Plus with the display side down, onto a protective surface.
   NOTE: Special care should be taken to insure that the front panel and glare screen are not scratched.

2. Remove the 4 screws from the corners of the back housing recess and the two screws in the center channel of the rear case.

3. Slowly lift the rear housing up and place in a safe location.

4. Disconnect battery connector (J4) from the Power Supply board.

4.6.2 Removal of the Front Bezel (2)

1. Place the front housing with the display side down, onto a protective surface.

2. Disconnect the SpO_2 ribbon cable (J3) from the CPU circuit board and the tubing from the NIBP front panel connector.

3. Slowly separate the assembly up and away from the front housing.

4.6.3 Removal of the Keyboard Assembly (4)

1. Place the instrument with the display side down, onto a protective surface.

2. Remove the Front Bezel, as described above.

3. Remove the screws securing the Keyboard Assembly and lift the keyboard, supporting and separating the connector to the CPU board.

4.6.4 Removal of the CPU Board Assembly (8)

1. **Remove rear housing, front bezel and keyboard assembly. Reminder: Battery must be disconnected.**

2. Lift the Recorder and Temperature modules floating connectors, off the locator pins on the main chassis.

3. Disconnect the ribbon cable connector (J1) from keyboard. **NOTE:** This is easier if the NIBP assembly end is disconnected first.

4. Disconnect the Interface connector ribbon cable, (J-3) from the CPU board.

5. Disconnect the Speaker connector from (J-6) from the CPU board. Check for other attached cables. Disconnect as required.

6. Remove the mounting screws from the CPU board. Leave the plastic insulator attached to the chassis. Use a piece of adhesive tape, if required, to secure the insulator to the chassis.

4.6.5 Removal of the NIBP Circuit Assembly (30)

1. Remove the rear housing of the monitor, as indicated above.

2. Disconnect Ribbon Cable connectors: (J1) to Filter board; (J2) to Power Supply board; (J4) to CPU board.

3. Disconnect plastic tubing from center port of air pump. Pull out the remaining plastic tubing, that was originally connected at the front panel cuff connector.

4. Remove the shield from the NIBP Module.

5. Remove the 3 screws from the NIBP Board; remove the board.

4.6.6 Removal of the Power Supply Assembly (41)

1. Remove the rear housing as indicated above.

2. Disconnect the ribbon cable at (J3).
   PRECAUTION: *Do not remove the screws located at the end of the circuit board: the board will not come out and may damage internal connections.*

3. Remove the two screws on the metal chassis/heat sink near J3, then remove two more screws at the AC power input end. (J2)

4. Slide the complete assembly out, about one inch.

5. Disconnect (J2) the AC connector from the circuit assembly and slide out the Power Supply assembly completely.

4.6.7 Removal of the Motor Filter (34) and LCD High Voltage Assembly (35)

NOTE: The Motor Filter board and LCD High Voltage circuits are mounted on a common metal heat sink and must be removed as one assembly.

1. Locate the assembly by tracing the wires from the air pump motor. Remove the three screws in the chassis, in the area between the AC power connector assembly and the back of the NIBP circuit.

2. Disconnect the LCD back light connector, (J1) and power connector, (J2).

3. Pull the assembly out towards the bottom of the unit and disconnect the ribbon connectors at J6 and J5.

4.6.8 Removal of the NIBP Air Pump Assembly (37)

1. Remove the Motor Filter and LCD High Voltage assembly.

2. Remove motor connector (J5), from the Motor Filter board.

3. Disconnect plastic tubing from center port of air pump.

4. Remove remaining motor bracket retaining screw, (the other screw was removed as part of the Motor Filter board removal) and slide air pump out of the retaining bracket.

4.6.9 Removal of the LCD Display Assembly and Back Light (5)

1. Disconnect LCD Back Light cable connector (J1) at the LCD high voltage module.

2. Disconnect the LCD ribbon cable at the right of the display.

3. Remove the two screws of the LCD mounting bracket, on the left side only.

4. Slide bracket out and disengage the LCD display from the right side bracket.

5. Remove the two screws attaching the back light.

4.6.10 Removal of the SpO_2 Circuit Board (40)

The SpO_2 circuit board is located in a cavity between the Power Supply board and the CPU board.

1. Disconnect the short ribbon cable from the CPU board (J7), to the SpO_2 circuit board.

2. Check and insure that the SpO_2 cable to the front panel connector has been disconnected during the front bezel removal.

3. Remove the four screws on the top end of the circuit board and pull the assembly out of the chassis.

4.6.11 Removal and replacement of the Internal Sealed Lead Acid or Li-Ion Battery

To remove the externally accessible battery, press the quick release tab on the battery access door and open door. The battery is retained internally in a sliding compartment, captured by a spring loaded release tab. Press the tab away from the battery; the battery will eject with a spring assist mechanism.

Reverse the process to install the replacement battery.

NOTE: New batteries are shipped in a discharged state for safety reasons. A new battery must be charged for 2 hours for Li-Ion or 8 hours for Sealed Lead Acid Battery before first use. The monitor may be used with AC mains power during the charge cycle but battery operation could be limited during this time.

4.6.12 Removal of the AC Input Receptacle Assembly (16)

1. Press the plastic locking tabs on the rear of the AC receptacle. A small screwdriver may be inserted at the cut out on the left of the AC connector, to release the locking tabs.

2. From the front side of the receptacle, starting at the edge closest to the Interface connector, press upwards, while pulling the connector out.

3. Disconnect the cable end from the Power Supply circuit board.

4. Remove the locking nuts from the safety ground terminal stud; remove ground conductor.

IMPORTANT NOTICE: *Never re-install an AC receptacle forcibly removed. The plastic locking tabs of the receptacle will be damaged, and if re-installed the receptacle may pull out in normal use.*

4.6.13 Thermal Printer (optional module)

1. Detach the complete module from the main NIBP section, by removing the two screws in the plastic housing. Grasp the plastic housing and pull to the rear to disengage the Interface connector.

2. Remove the two screws retaining the circuit board and the anti static shield assembly. Remove the shield.

3. Remove the remaining two screws and lift the circuit board out.

4.6.14 Thermometer, Predictive (optional module)

1. Detach the complete module from the main NIBP section by removing the two screws in the plastic housing. Grasp the plastic housing and pull to the rear to disengage the interface connector.

2. Disconnect the 9 V battery. **NOTE:** Newer modules do not contain a battery. Skip this step.

3. Remove J2 and J3 connectors from the circuit board to front panel input receptacle. **NOTE:** The connectors may be reversed or interchanged without affecting final function.

4. Remove the three screws securing the circuit board and anti static shield. Remove the assembly.

4.6.15 AccuTemp IR, Infrared Thermometer (optional module)

The AccuTemp has no user accessible adjustments or replaceable parts, except for the 9 Volt battery. If problems arise, contact Datascope Technical Service.

4.6.16 AccuTemp IR Mounting Cradle

The mounting cradle has no adjustments or replaceable parts. The mounting cradle houses a small circuit board and a photocell sensor.

4.6.17 Communication Board (45)

1. Disconnect the rear panel 9 pin RS232 connector.

2. Disconnect the 3 pin connector on the top of the Communication Board leading to the phone jack by the rear panel.

3. Remove the 3 mounting screws securing the Communication Board to the chassis.

4. Trace the wider ribbon cable (remove the NIBP shield) to the CPU Board. Disconnect the connector. (NOTE: The keyboard may have to be removed for clearance.)

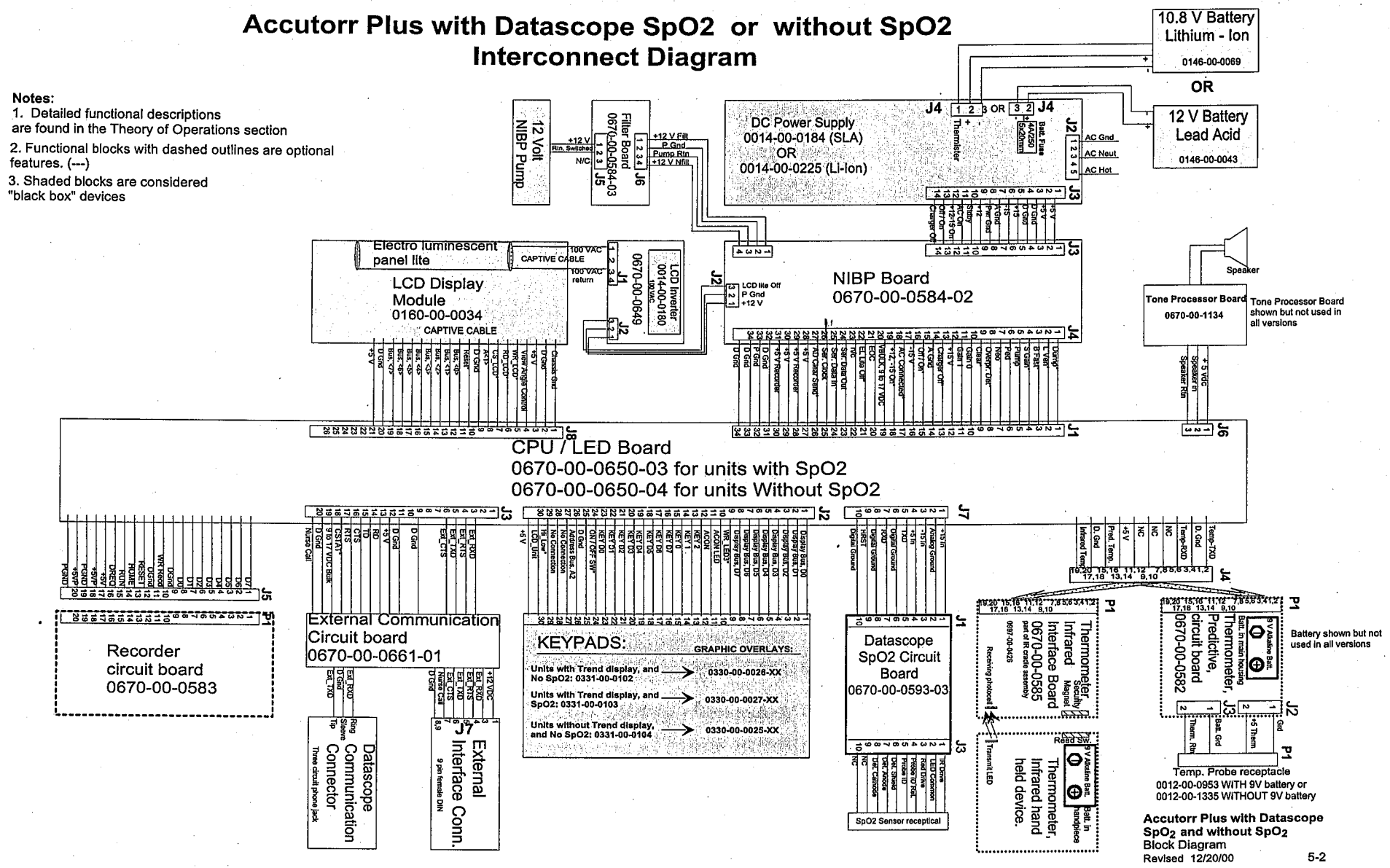
This page intentionally left blank.

5.0 ASSEMBLY AND SCHEMATIC DIAGRAMS

Schematic drawings and accompanying assembly drawings of printed circuit boards are provided in the remainder of this chapter.

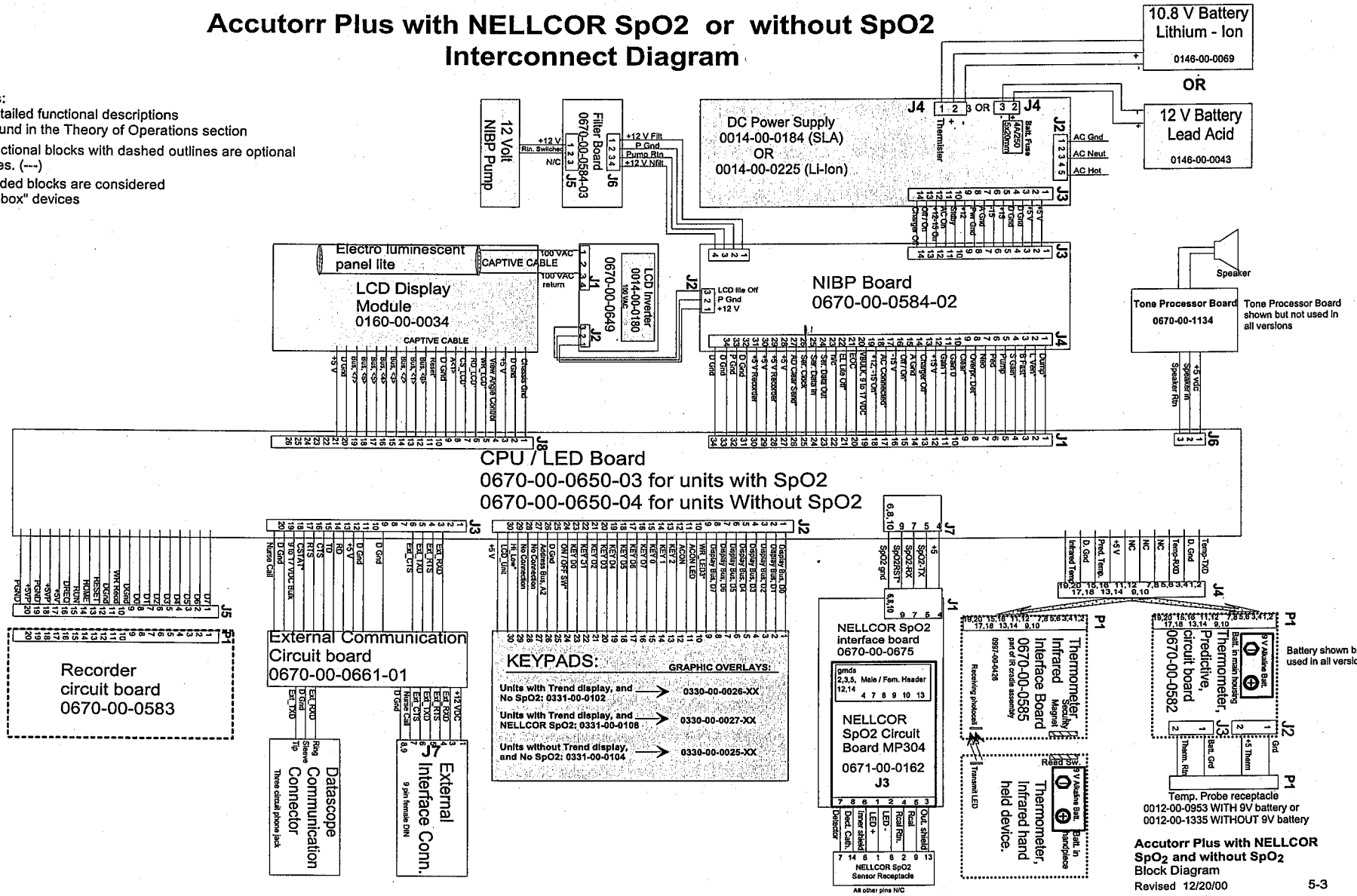
The following is a list of the drawings and the corresponding drawing number (if available) and the page where it can be found.

Accutorr Plus with Datascope SpO2 or without SpO2 Interconnect Diagram



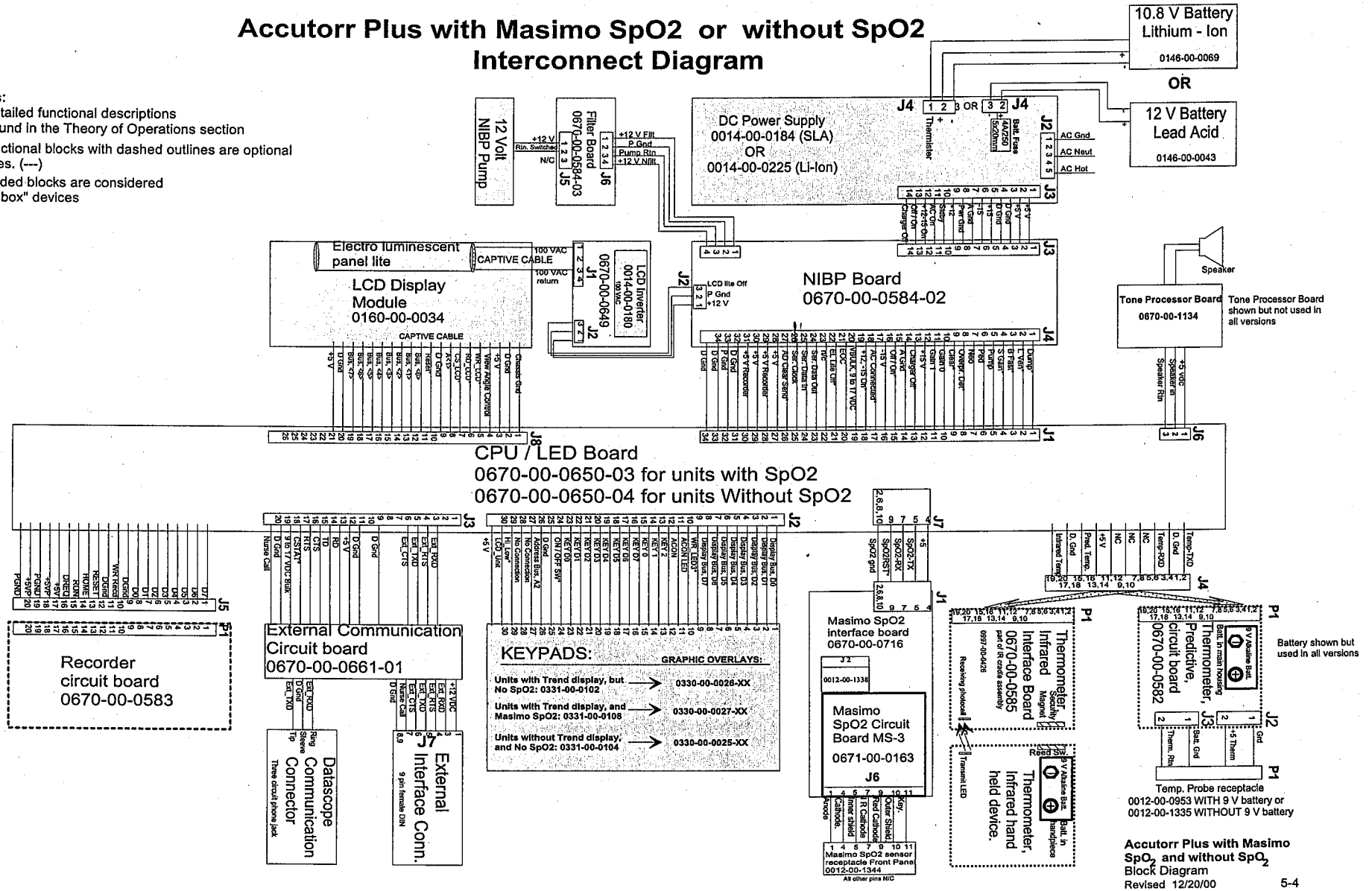
Accutorr Plus with Datascope SpO_2 and without SpO_2
Block Diagram
Revised 12/20/00

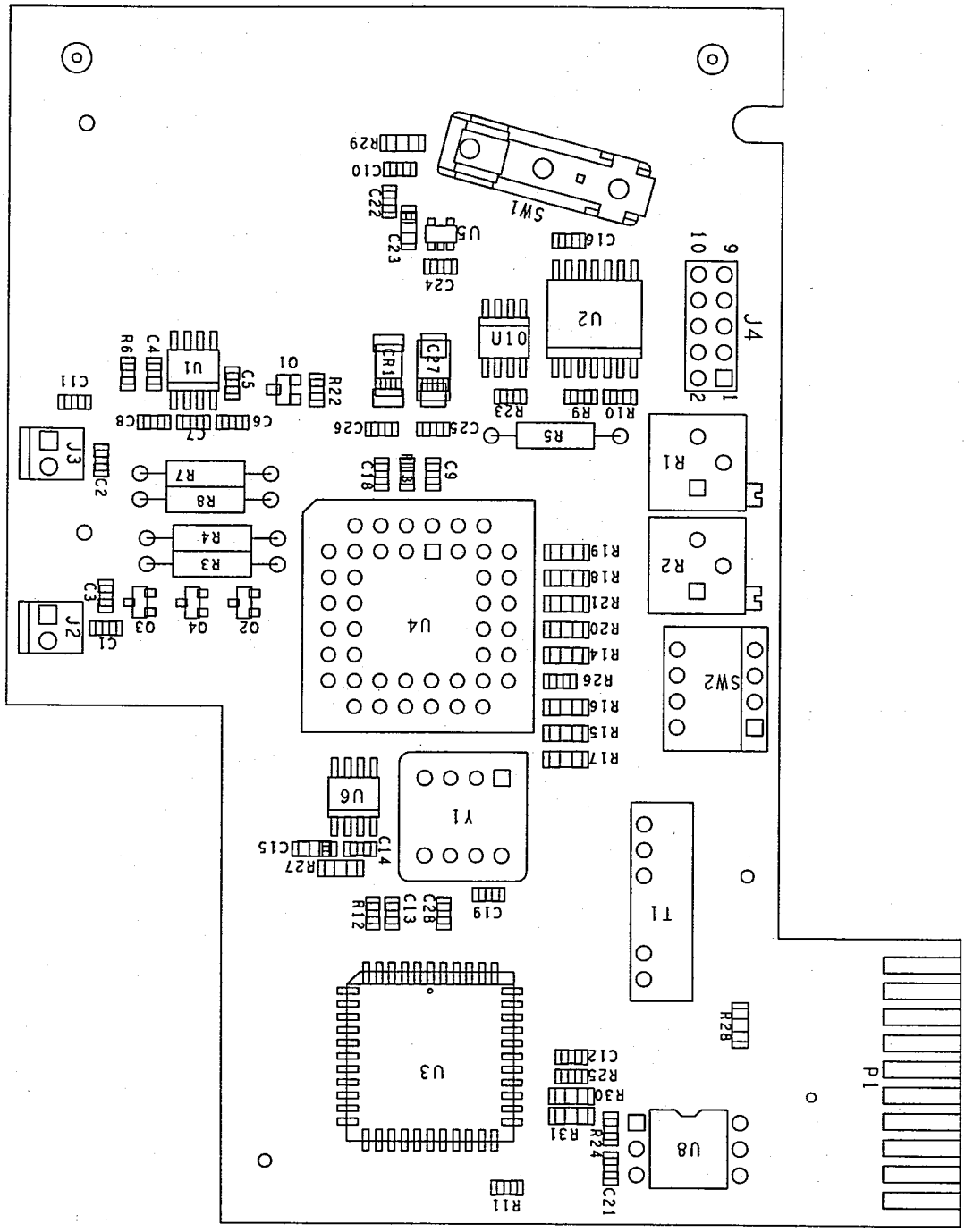
Accutorr Plus with NELLCOR SpO2 or without SpO2 Interconnect Diagram



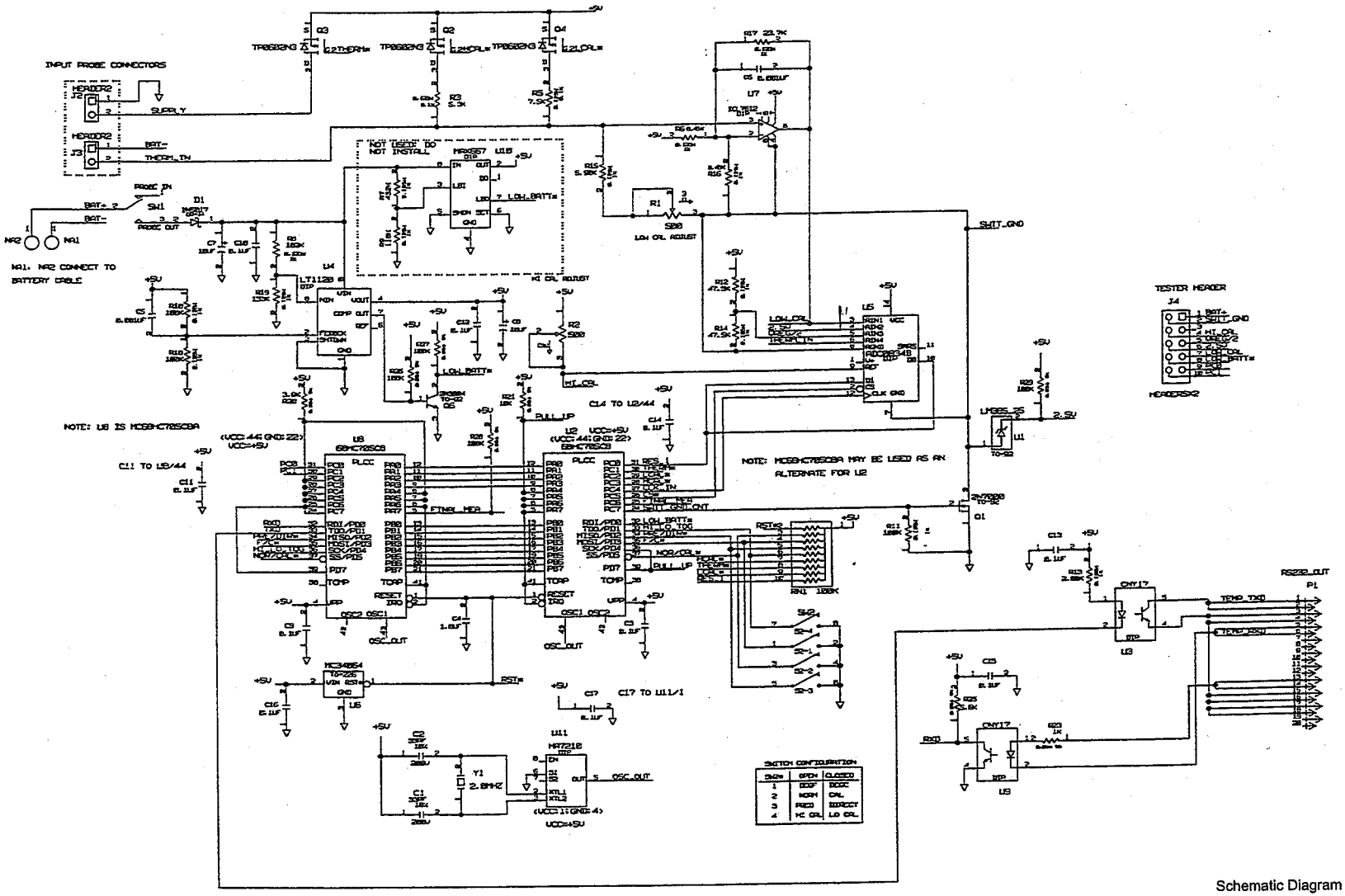
Accutorr Plus with NELLCOR SpO_2 and without SpO_2
Block Diagram
Revised 12/20/00

Accutorr Plus with Masimo SpO2 or without SpO2 Interconnect Diagram

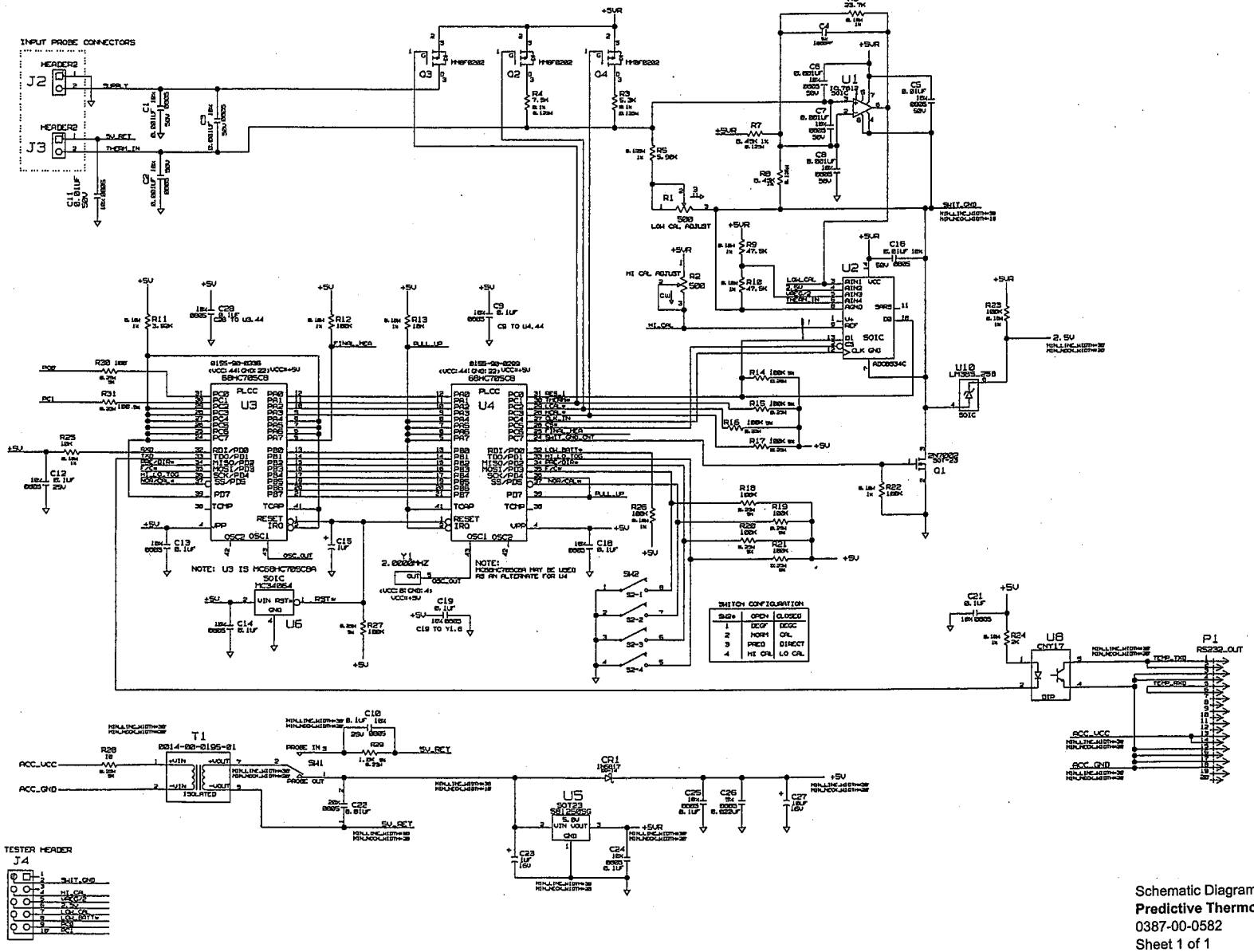




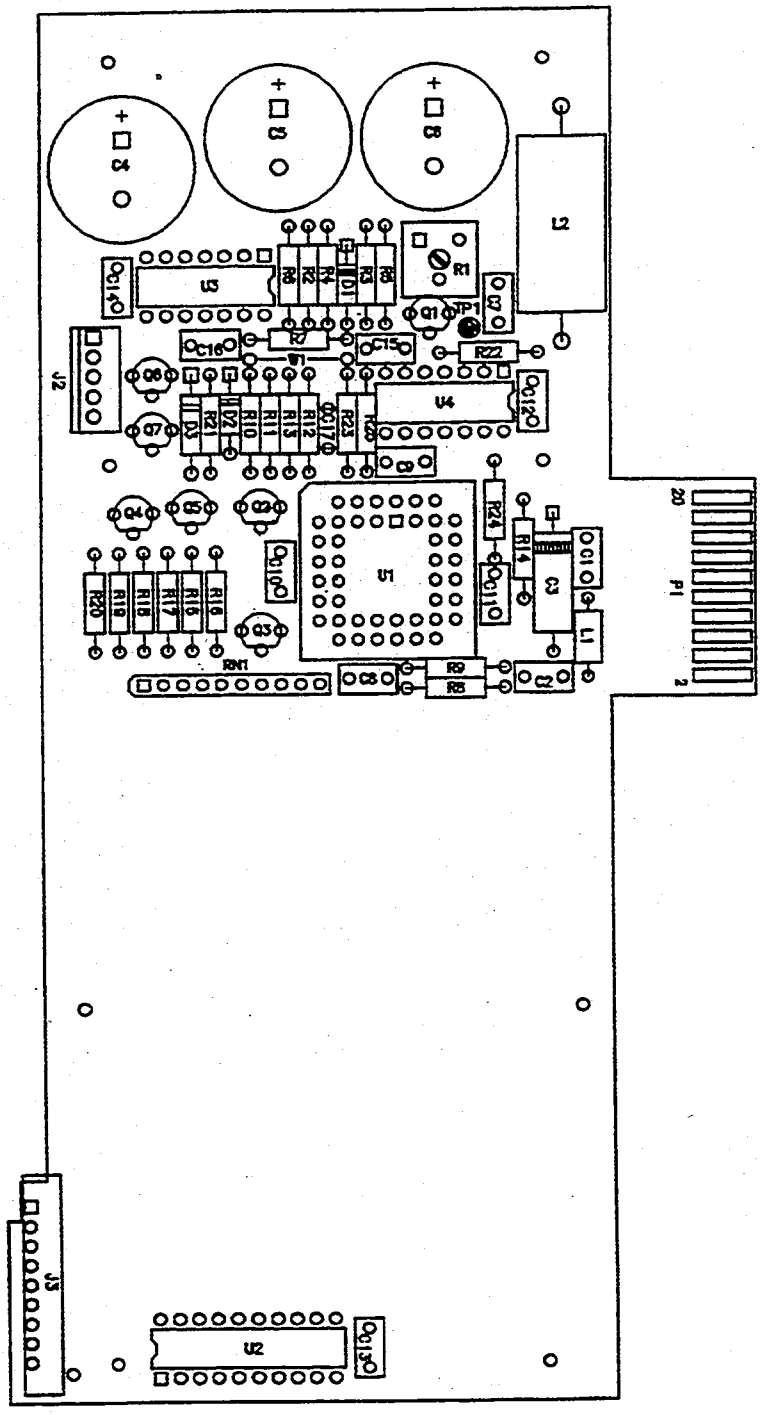
Predictive Thermometer Board
0670-00-0582
Revised 12/20/00



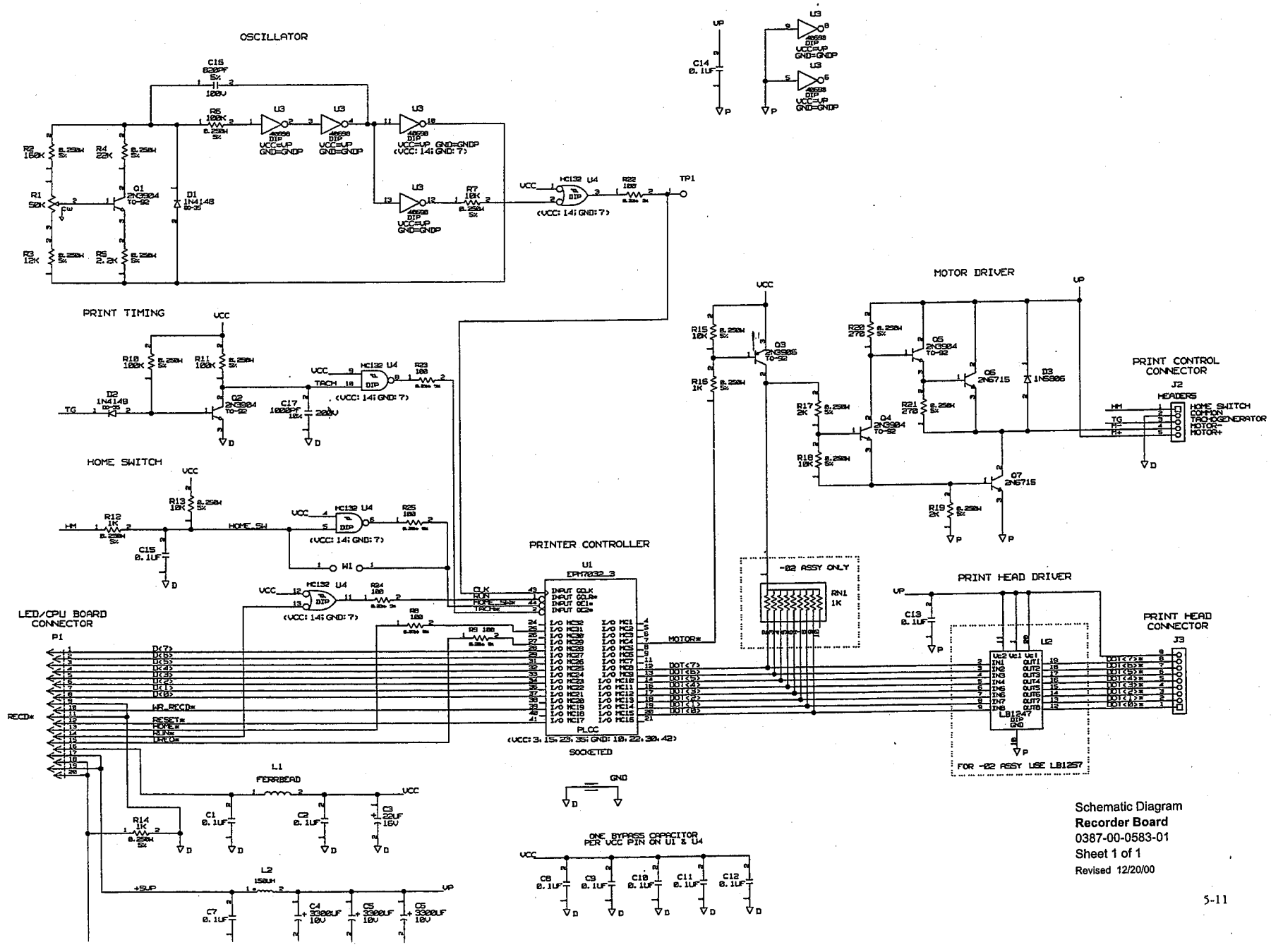
Schematic Diagram
Predictive Thermometer Board with Battery
0387-00-0582
Sheet 1 of 1
Revised 12/20/00

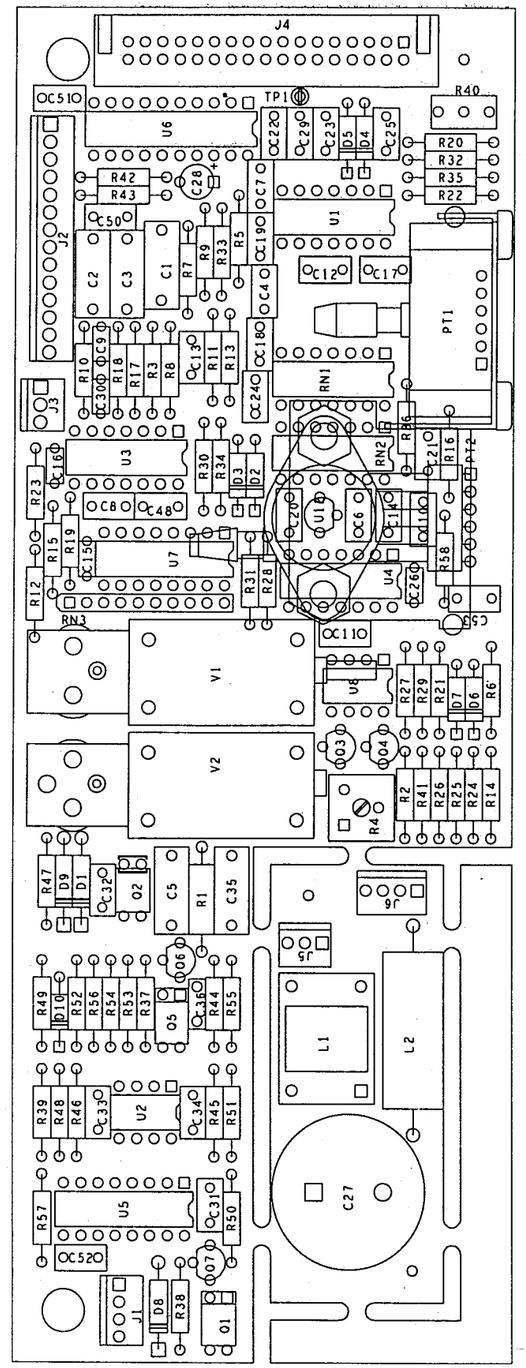


Schematic Diagram
Predictive Thermometer Board
0387-00-0582
Sheet 1 of 1
Revised 12/20/00

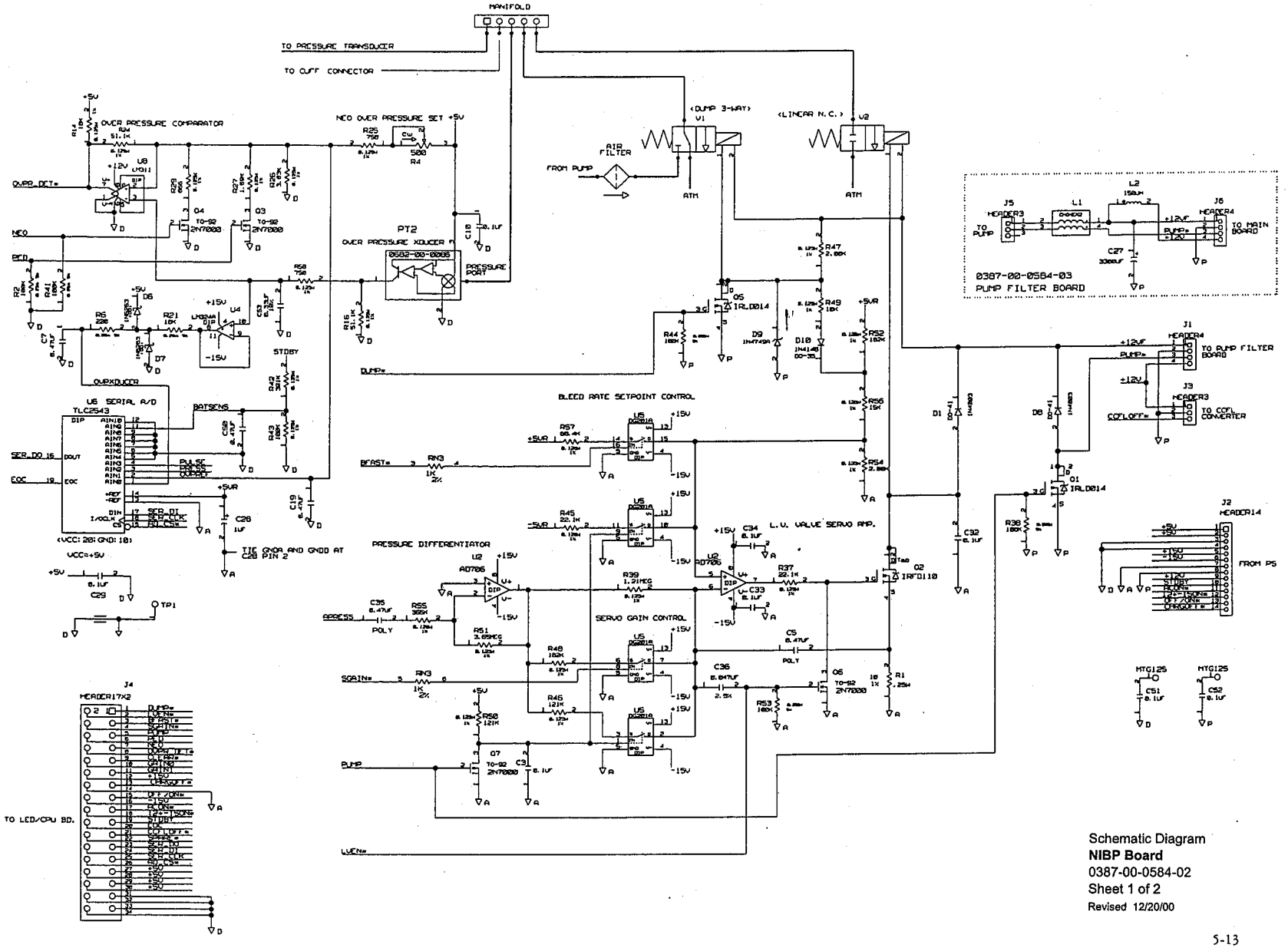


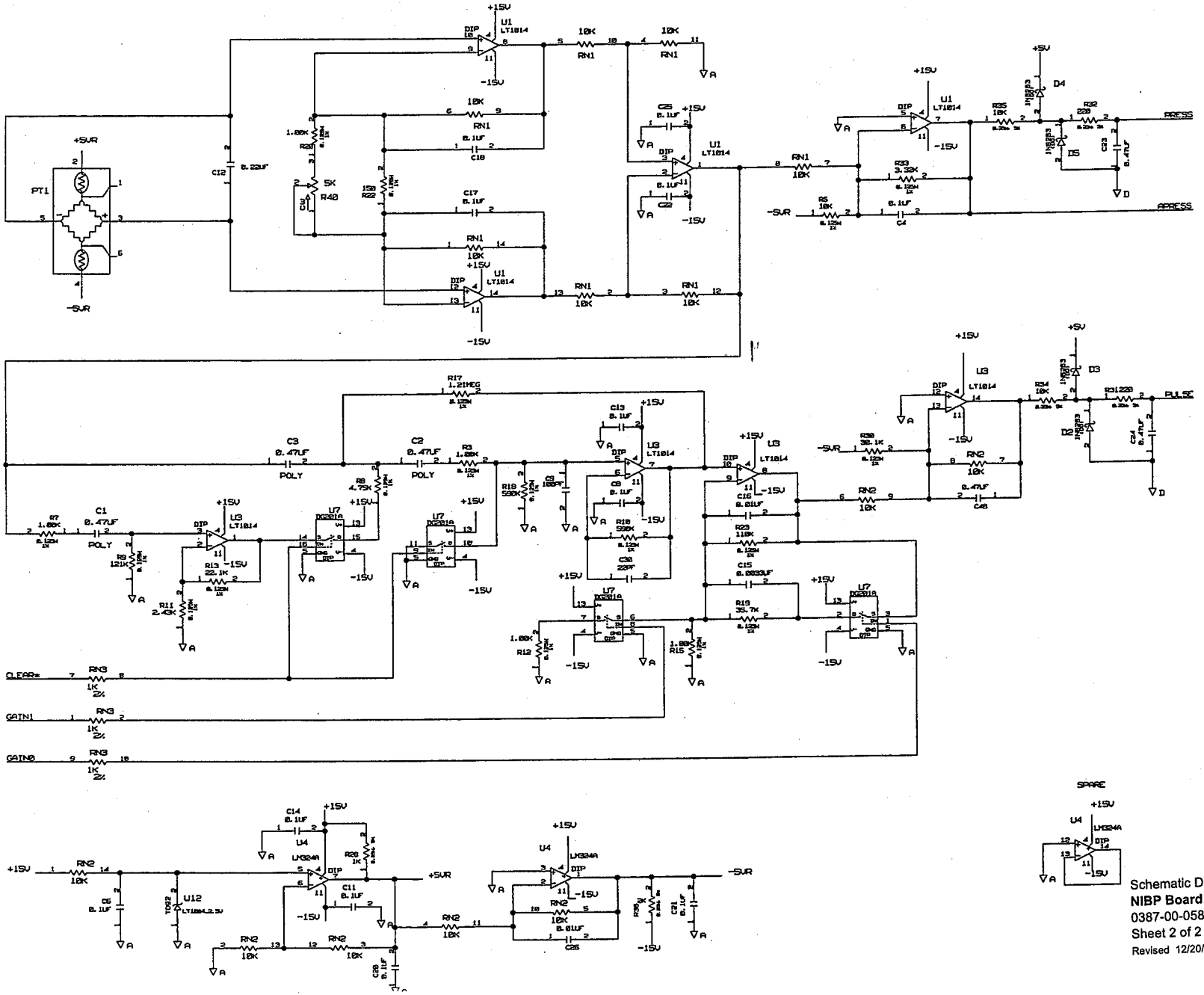
Recorder Board
0670-00-0583-01
Revised 12-20-00

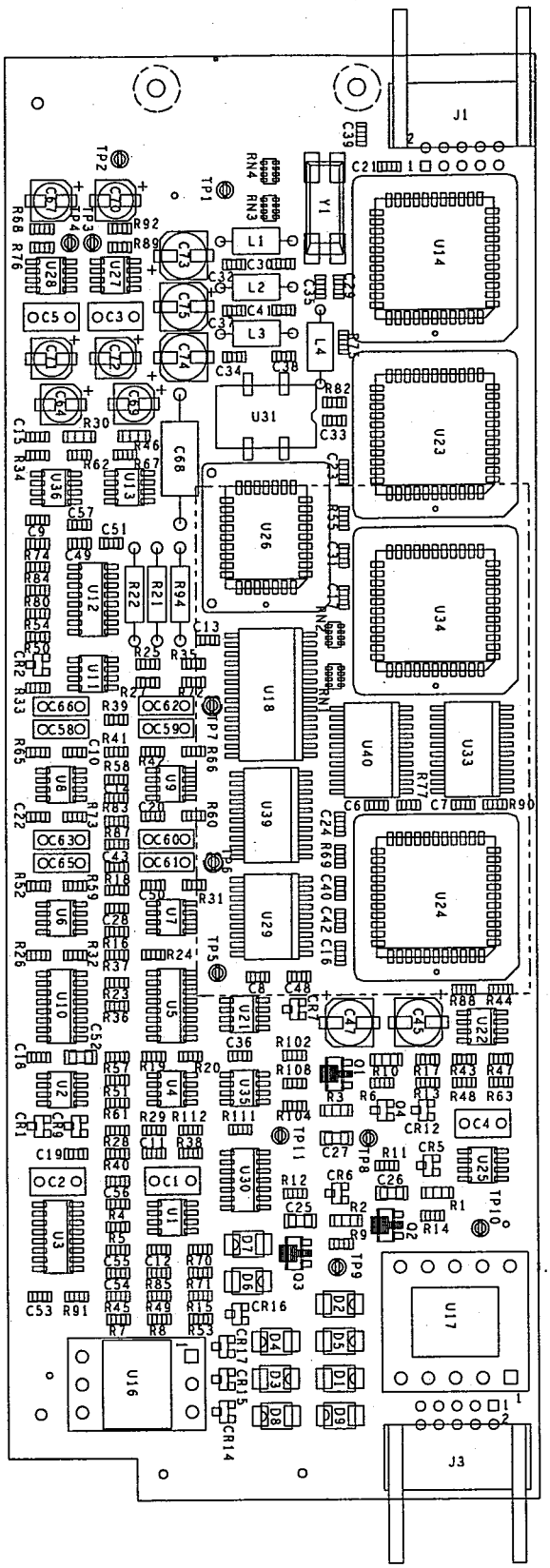

OSCILLATOR
PRINT TIMING
HOME SWITCH
MOTOR DRIVER
PRINT CONTROL CONNECTOR
PRINTER CONTROLLER
PRINT HEAD DRIVER
LED/CPU BOARD CONNECTOR
PRINT HEAD CONNECTOR
-02 ASSY ONLY
FOR -02 ASSY USE LB1257
ONE BYPASS CAPACITOR PER VCC PIN ON U1 & U4
Schematic Diagram
Recorder Board
0387-00-0583-01
Sheet 1 of 1
Revised 12/20/00



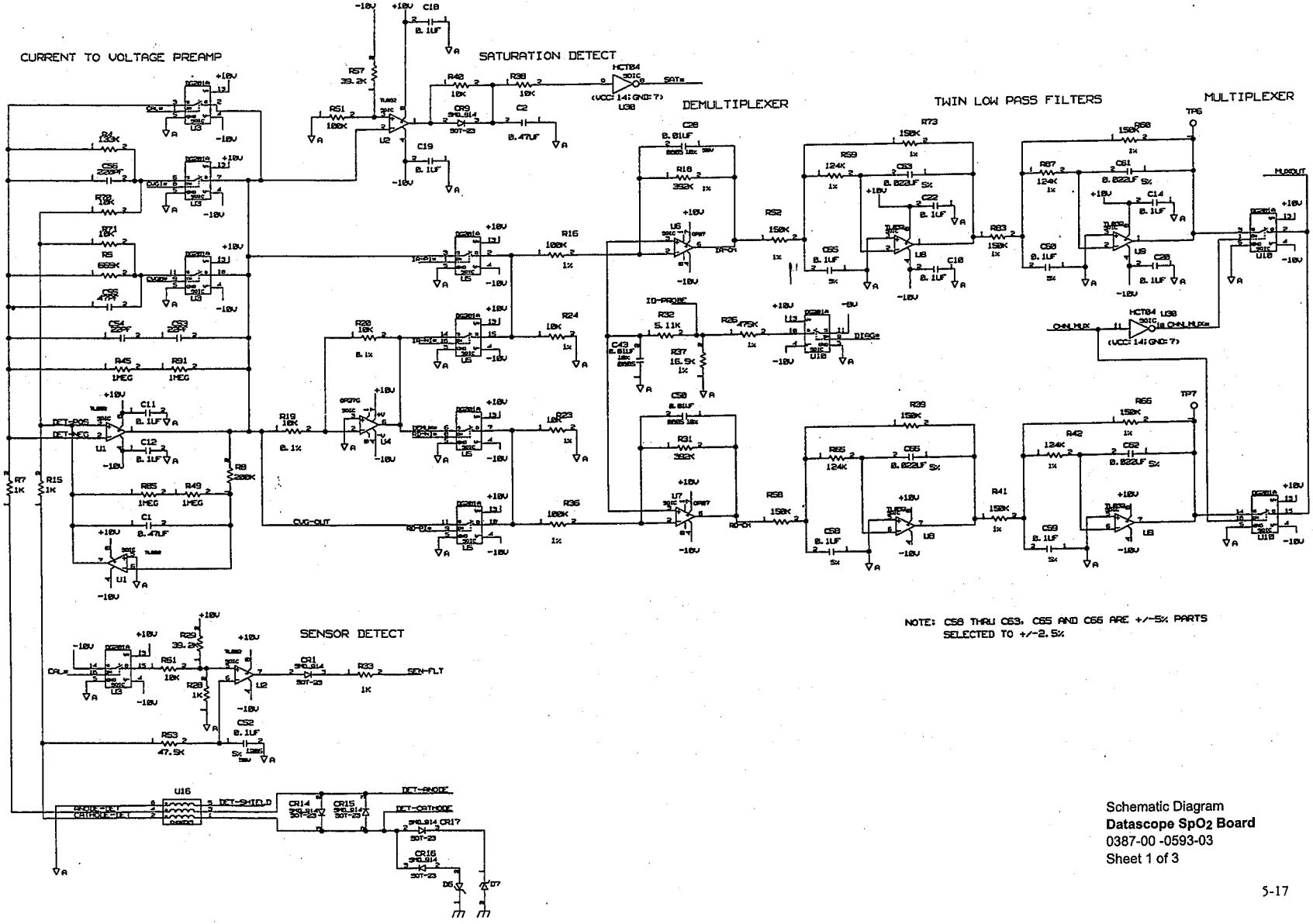
NIBP Board
0670-00-0584-02
Revised 12/20/00


MANIFOLD
TO PRESSURE TRANSDUCER
TO CUFF CONNECTOR
(DUMP 3-WAY)
V1
(LINEAR N.C.)
V2
AIR FILTER
FROM PUMP
ATM
ATM
OVER PRESSURE COMPARATOR
NEO OVER PRESSURE SET
PT2
OVER PRESSURE XDUCER
PRESSURE PORT
0387-00-0584-03
PUMP FILTER BOARD
TO PUMP
TO MAIN BOARD
TO PUMP FILTER BOARD
TO CCFL CONVERTER
FROM P5
BLEED RATE SETPOINT CONTROL
L.V. VALVE SERVO AMP.
PRESSURE DIFFERENTIATOR
SERVO GAIN CONTROL
U6 SERIAL A/D
TLC2543
TIE GNDA AND GNDD AT C28 PIN 2
TO LED/CPU BD.
Schematic Diagram
NIBP Board
0387-00-0584-02
Sheet 1 of 2
Revised 12/20/00

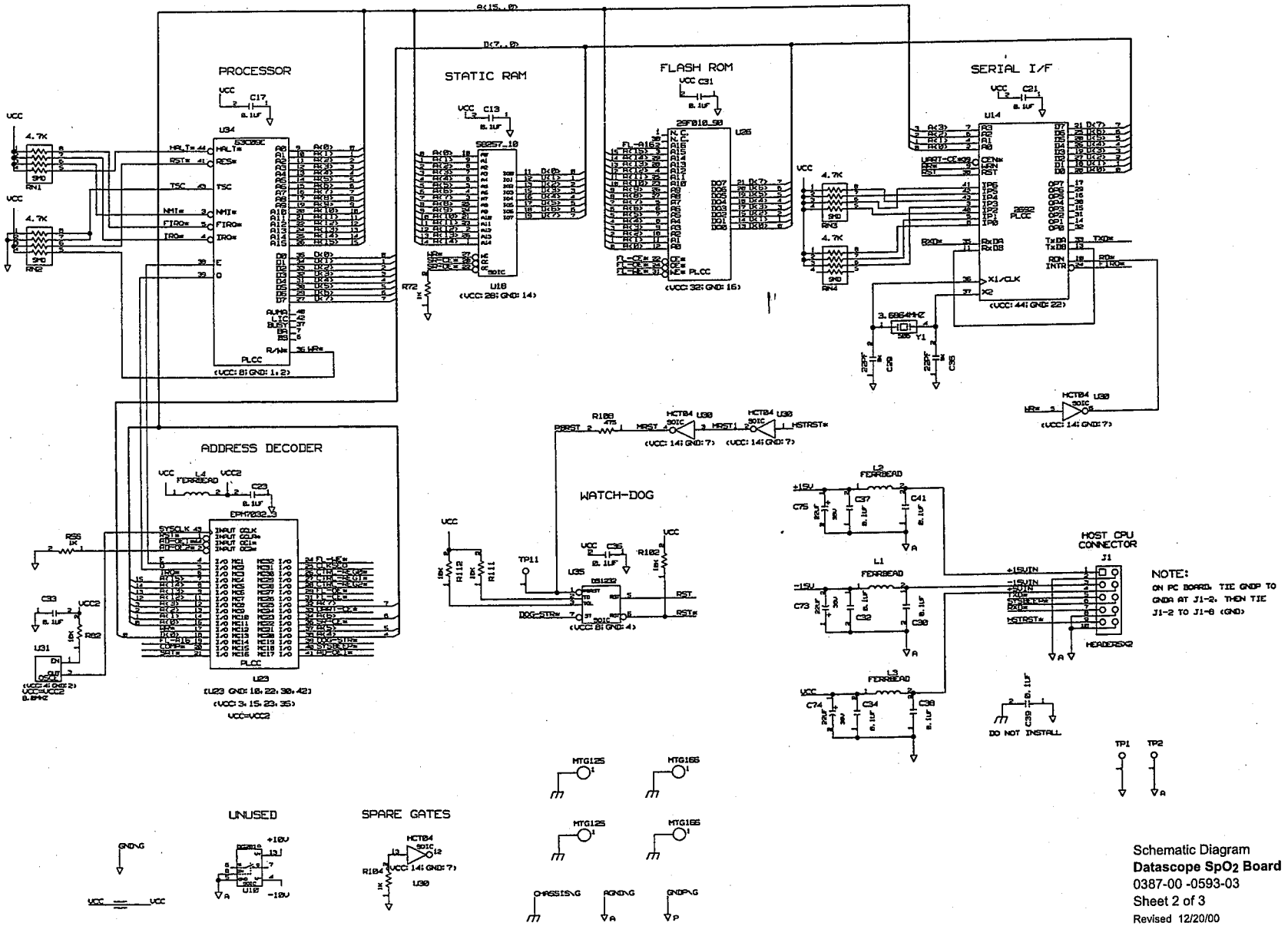

+15V
-15V
+5V
-5V
PT1
5K
R40
PRESS
APRESS
PULSE
POLY
CLEAR*
GAIN1
GAIN0
SPARE
Schematic Diagram
NIBP Board
0387-00-0584-02
Sheet 2 of 2
Revised 12/20/00



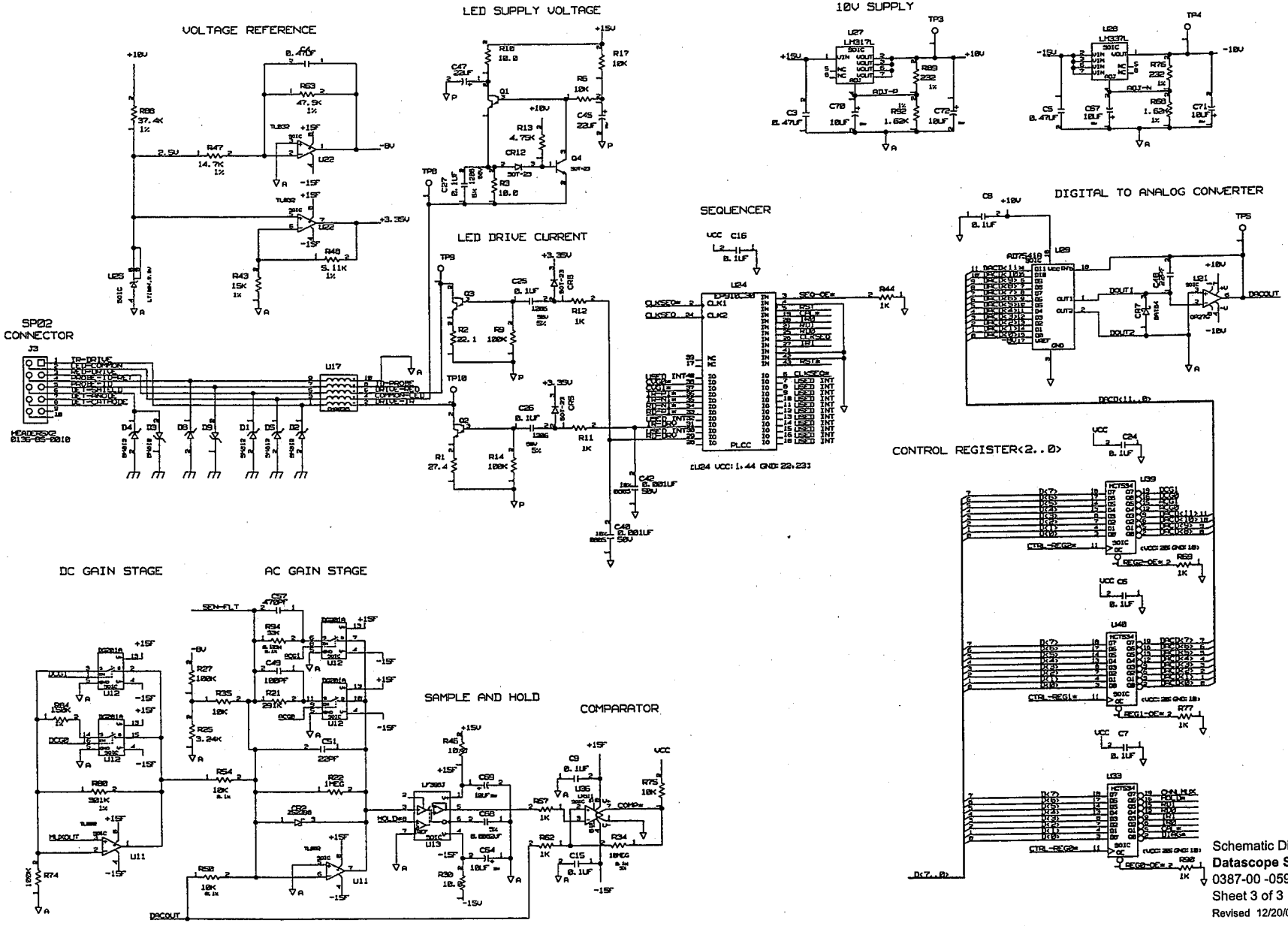
Datascope
SpO2 Board
0670-00-0593-03
Revised 12/21/00



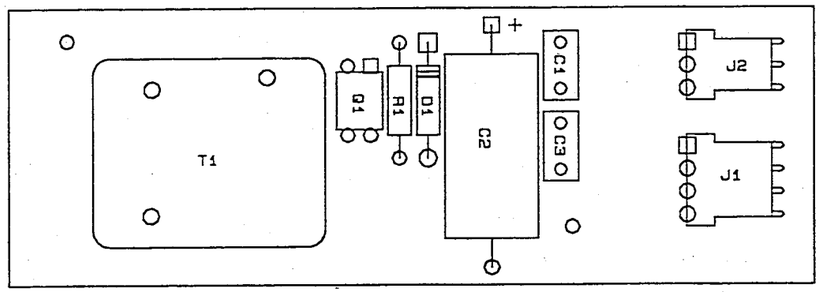
Schematic Diagram
Datascope SpO$_2$ Board
0387-00 -0593-03
Sheet 1 of 3



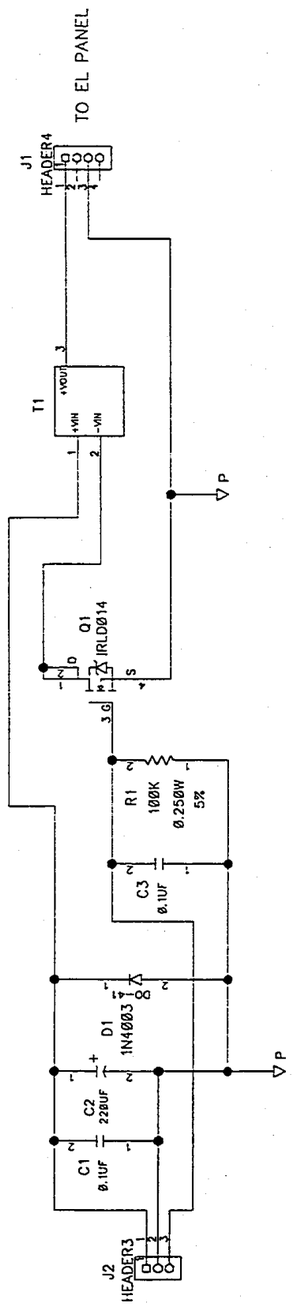
Schematic Diagram
Datascope SpO_2 Board
0387-00 -0593-03
Sheet 2 of 3
Revised 12/20/00



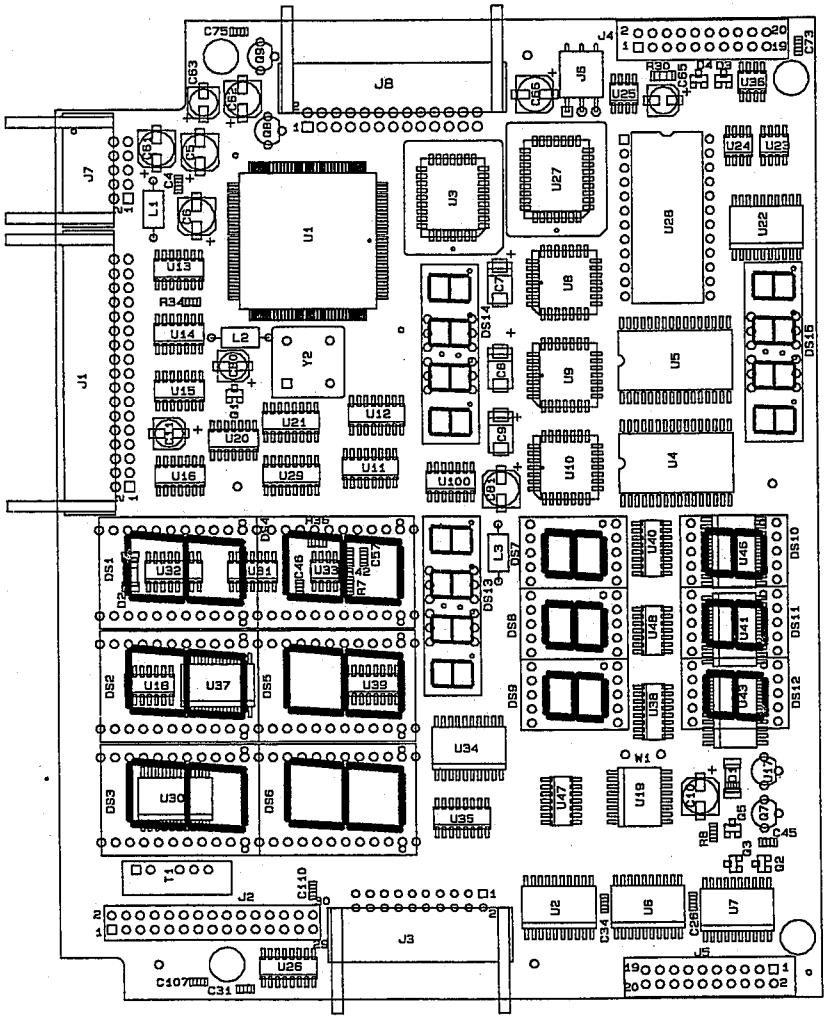
Schematic Diagram
Datascope SpO_2 Board
0387-00 -0593-03
Sheet 3 of 3
Revised 12/20/00



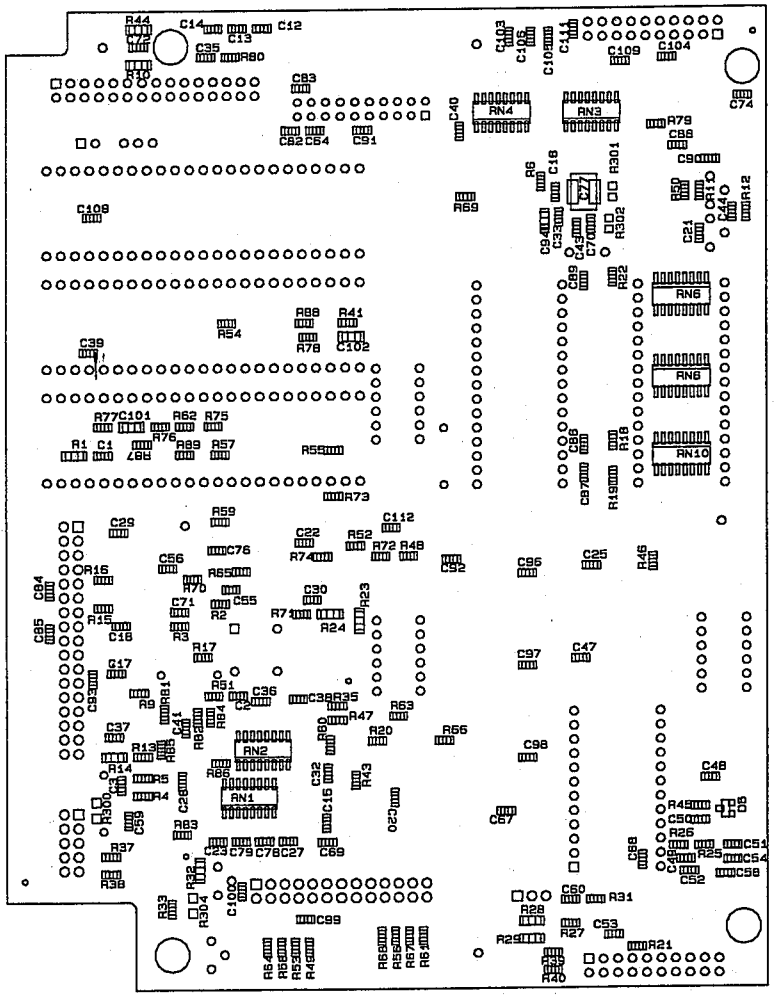
LCD Backlite Power Supply Board
0670-00-0649
Revised 12/20/00



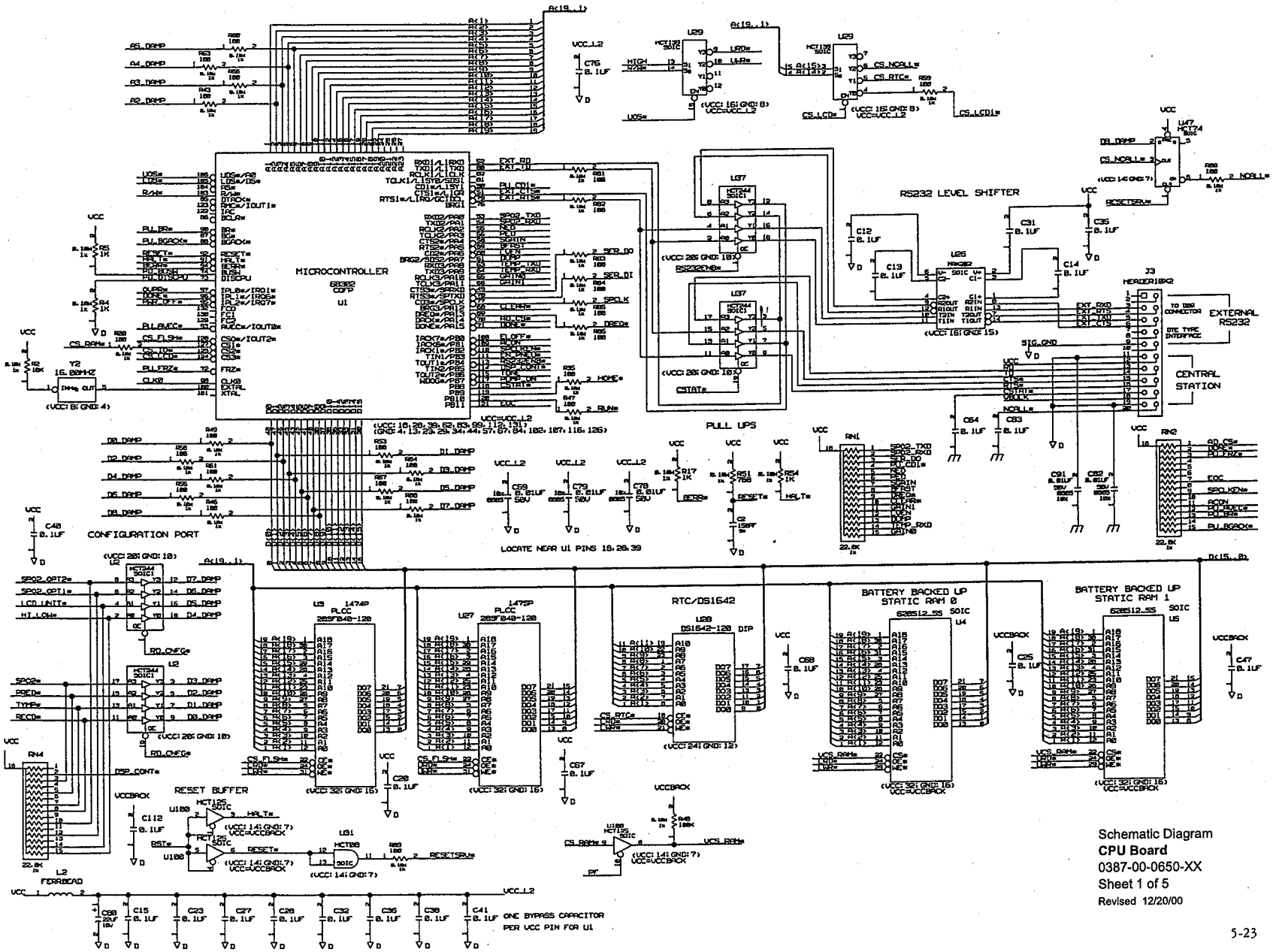
Schematic Diagram
LCD Backlite Power Supply Board
0387-00-0649
Sheet 1 of 1
Revised 12/20/00



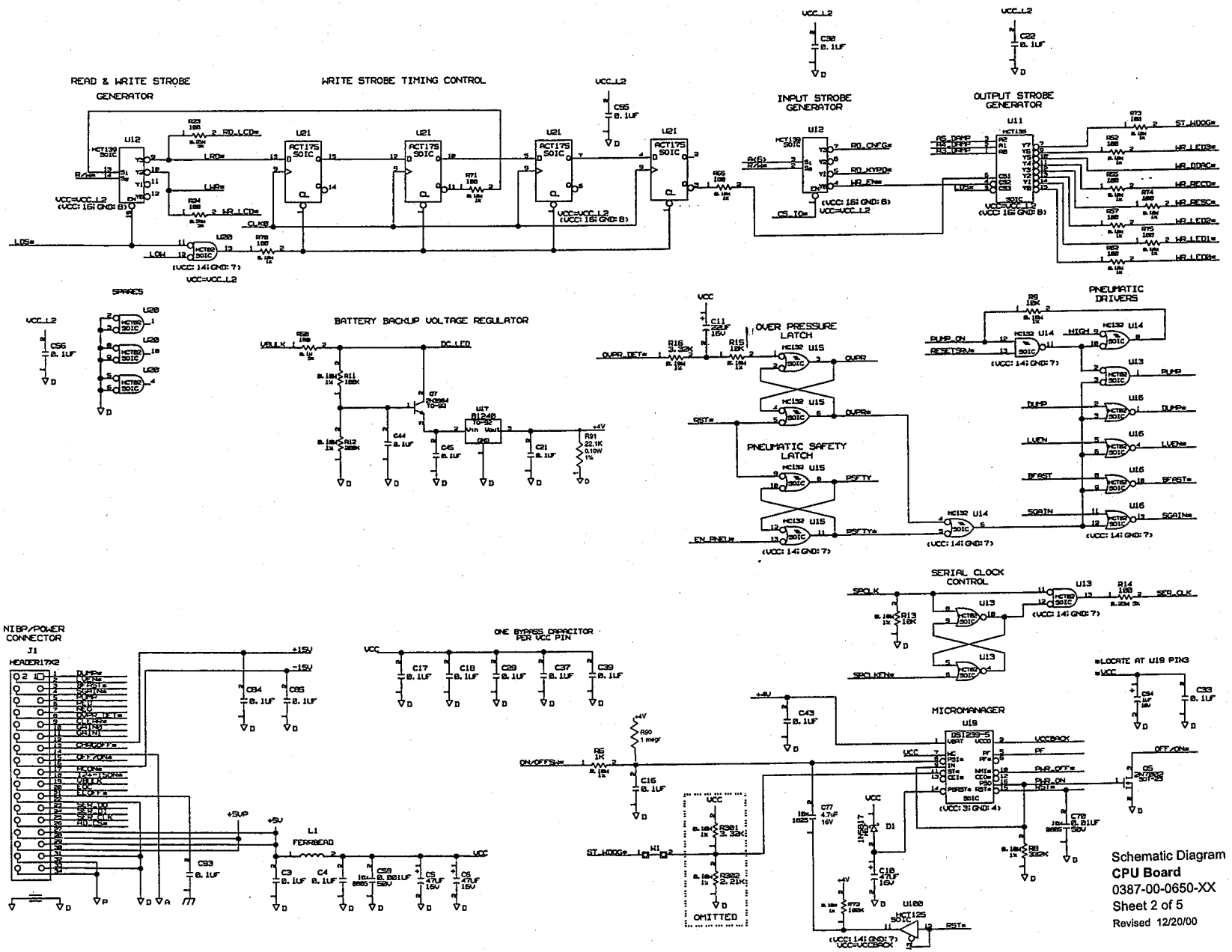
CPU Board (top side)
0670-00-0650-03/04
(-03with SpO_2, -04 without SpO_2)



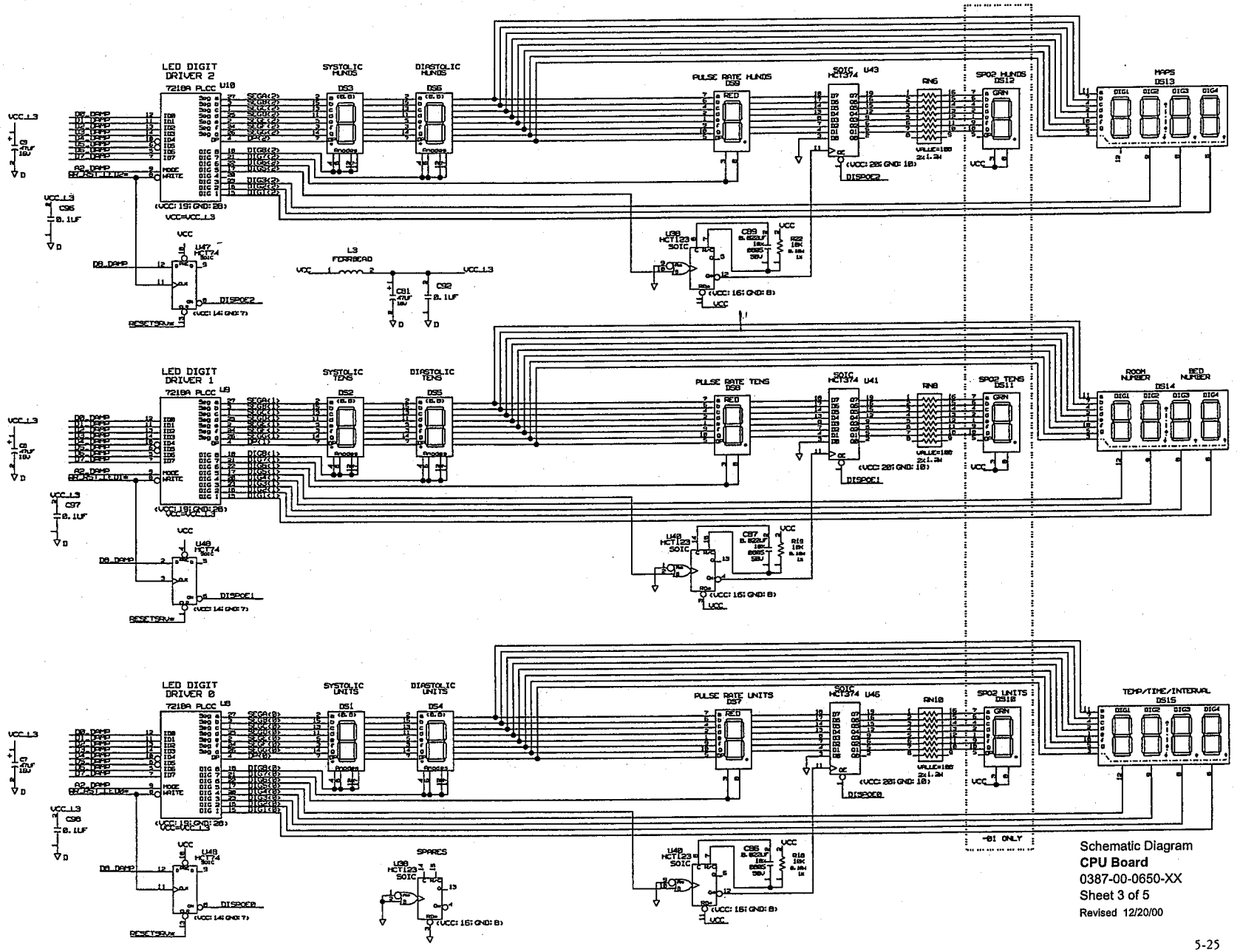
CPU Board (bottom side)
0670-00-0650-03/04
(-03with SpO_2, -04 without SpO_2)
Revised 12/20/00



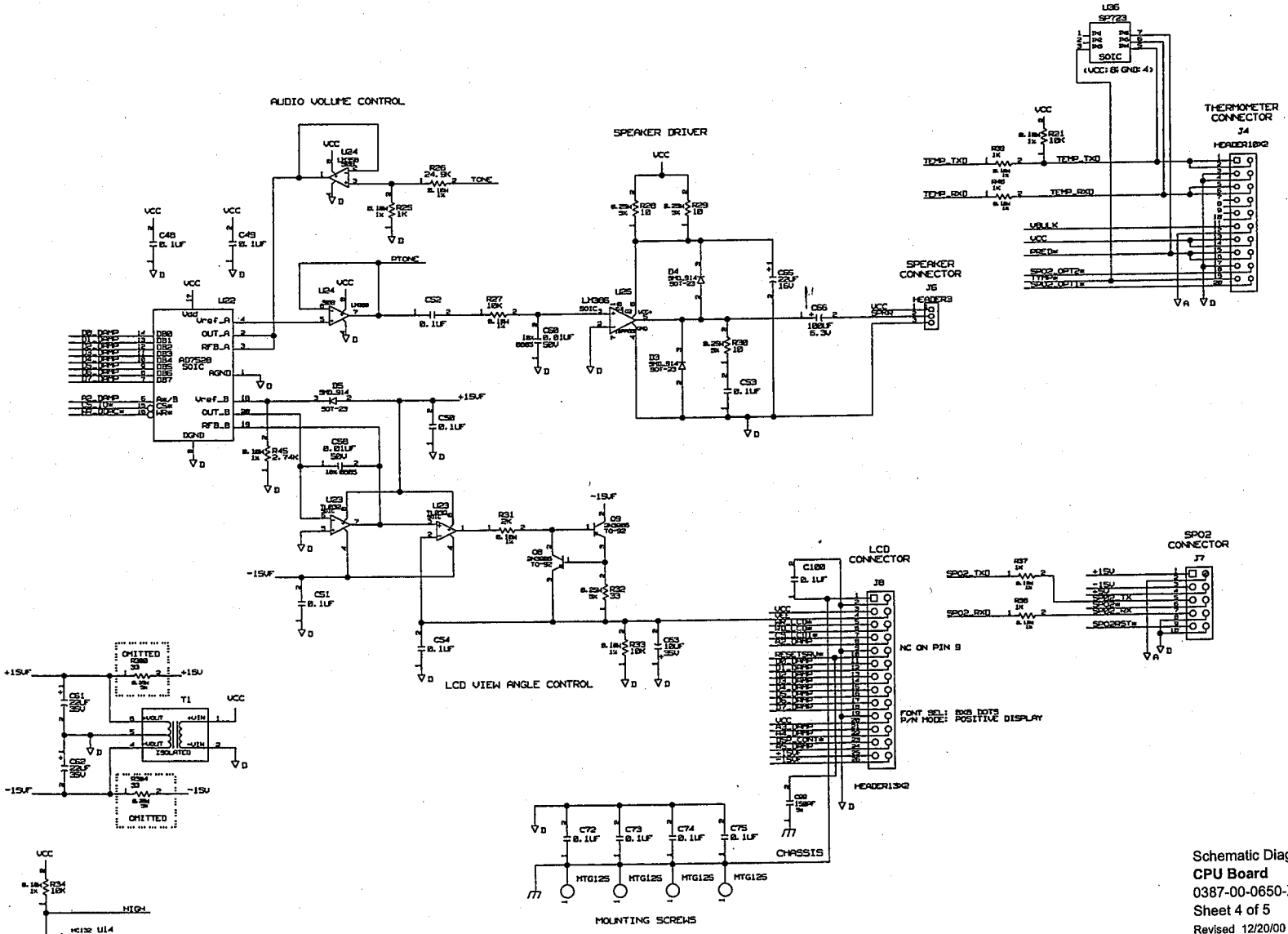
Schematic Diagram
CPU Board
0387-00-0650-XX
Sheet 1 of 5
Revised 12/20/00



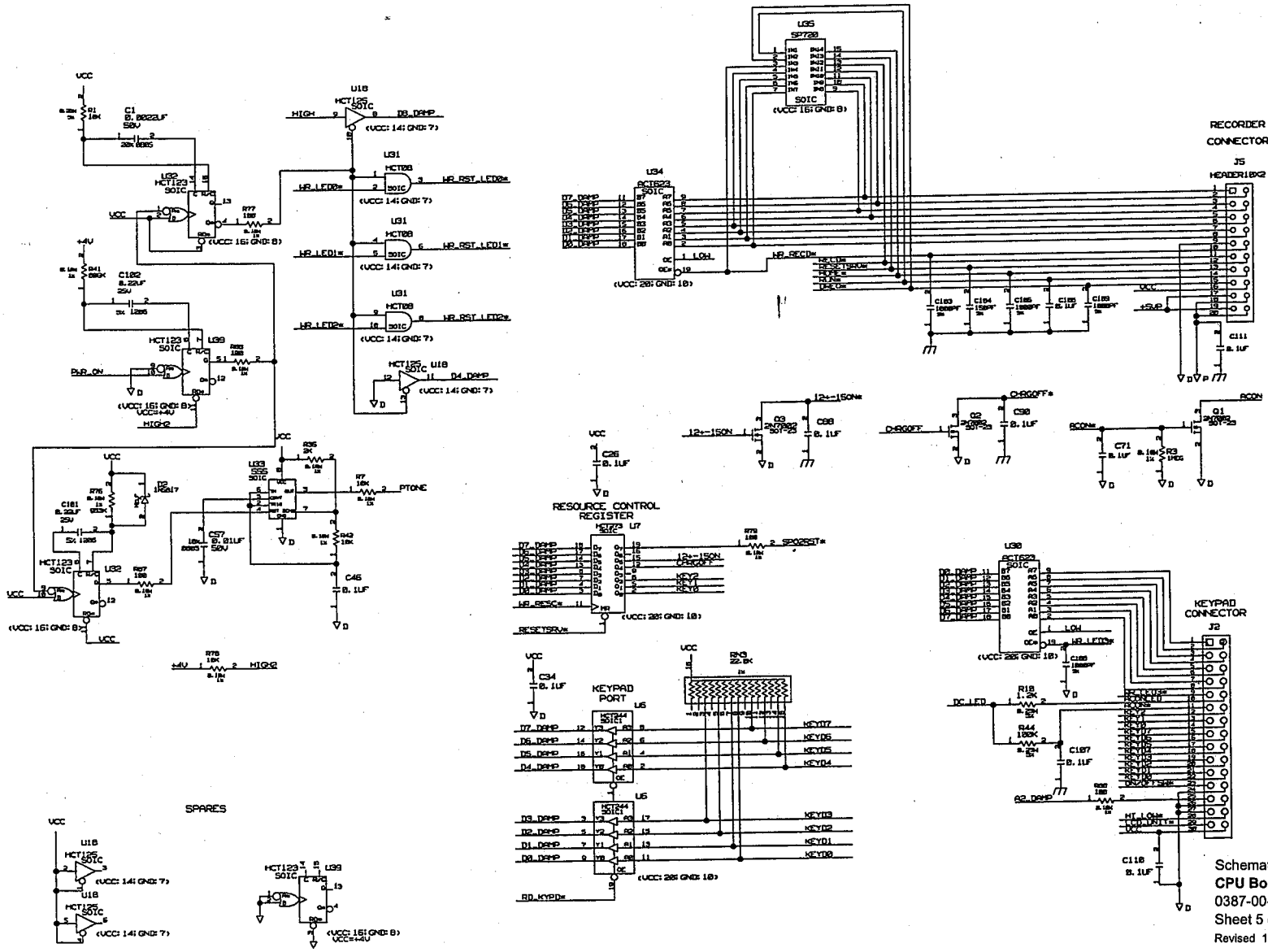
Schematic Diagram
CPU Board
0387-00-0650-XX
Sheet 2 of 5
Revised 12/20/00

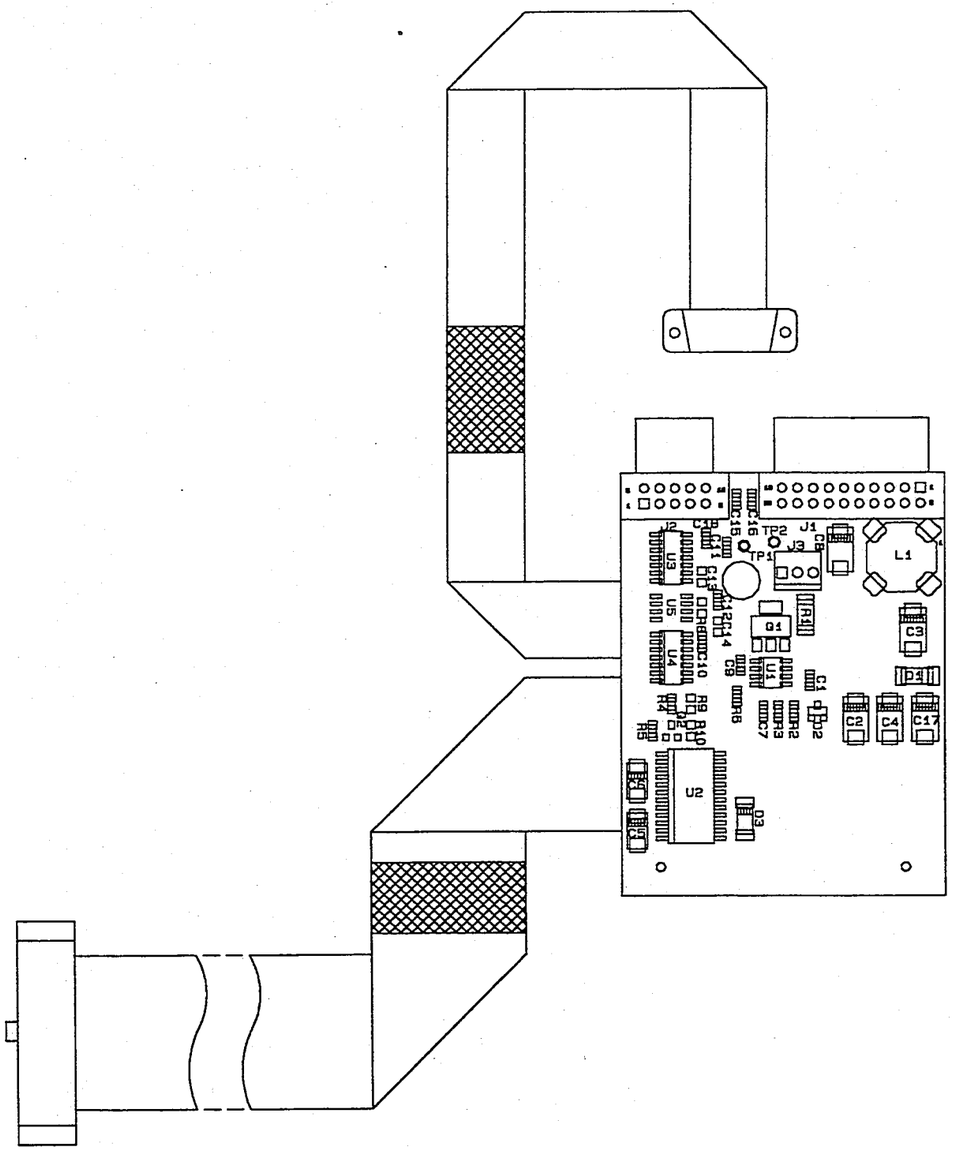


Schematic Diagram
CPU Board
0387-00-0650-XX
Sheet 3 of 5
Revised 12/20/00

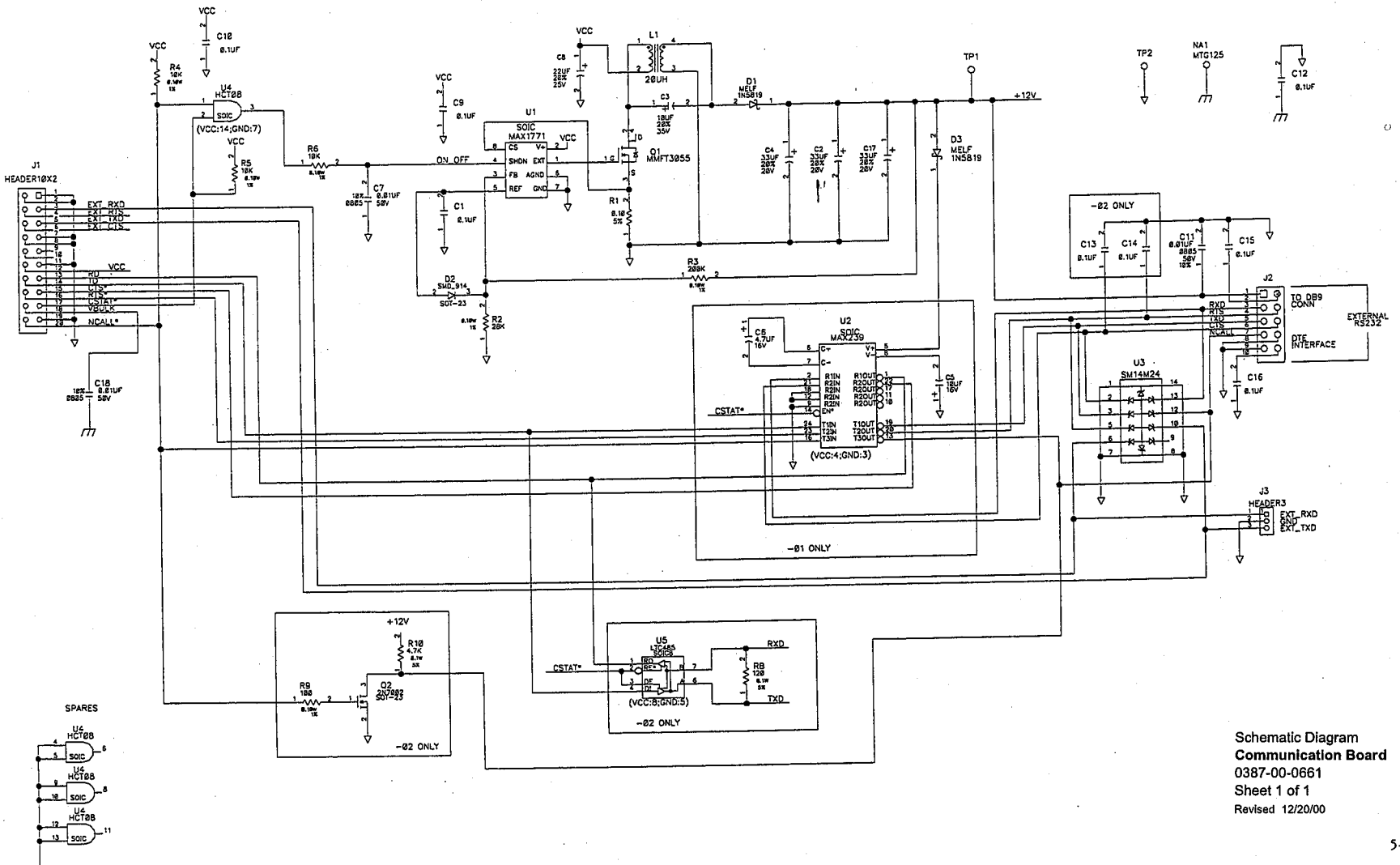


Schematic Diagram
CPU Board
0387-00-0650-XX
Sheet 4 of 5
Revised 12/20/00

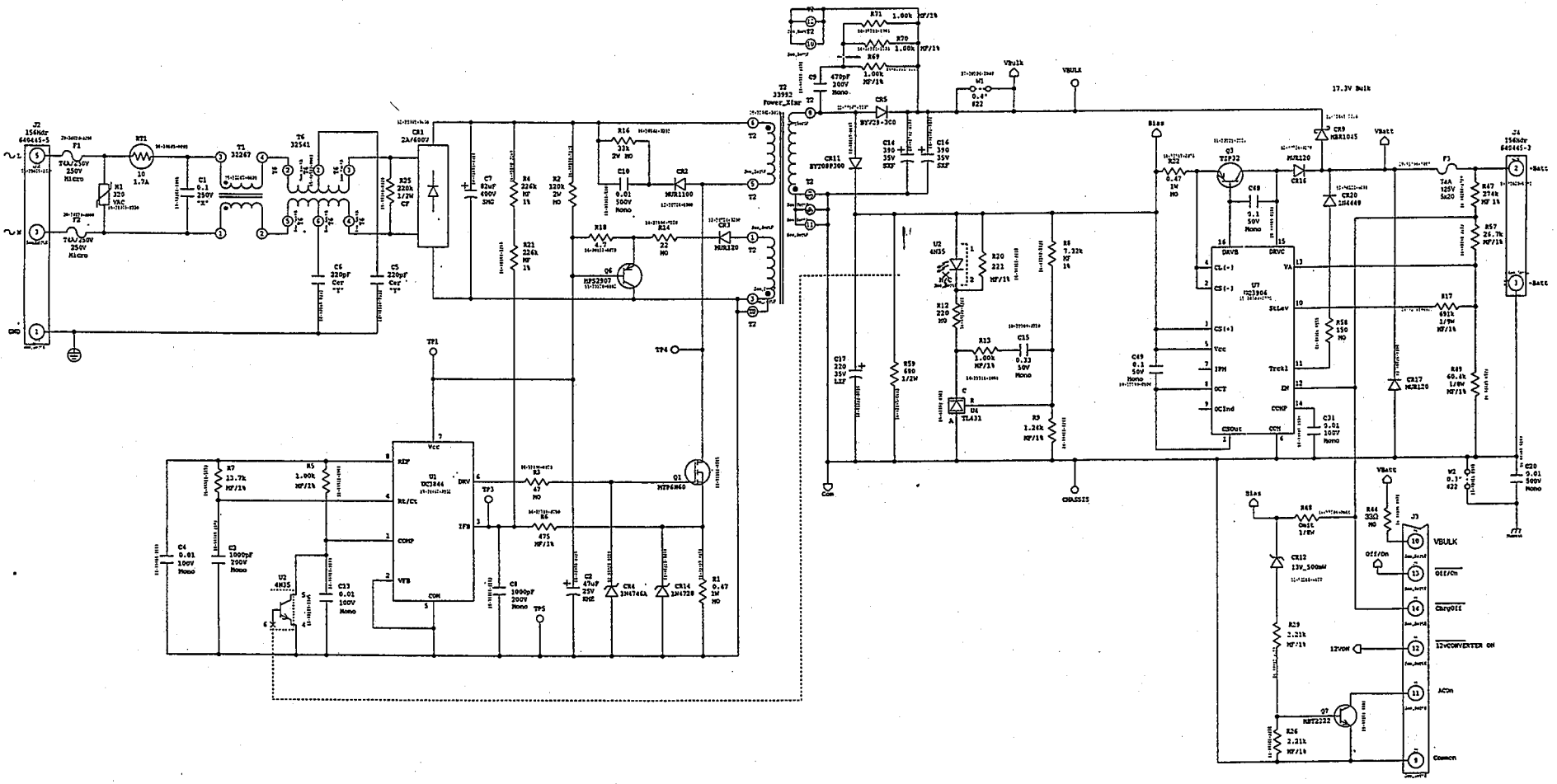

RECORDER CONNECTOR
J5
HEADER10X2
KEYPAD CONNECTOR
J2
RESOURCE CONTROL REGISTER
KEYPAD PORT
SPARES
Schematic Diagram
CPU Board
0387-00-0650-XX
Sheet 5 of 5
Revised 12/20/00



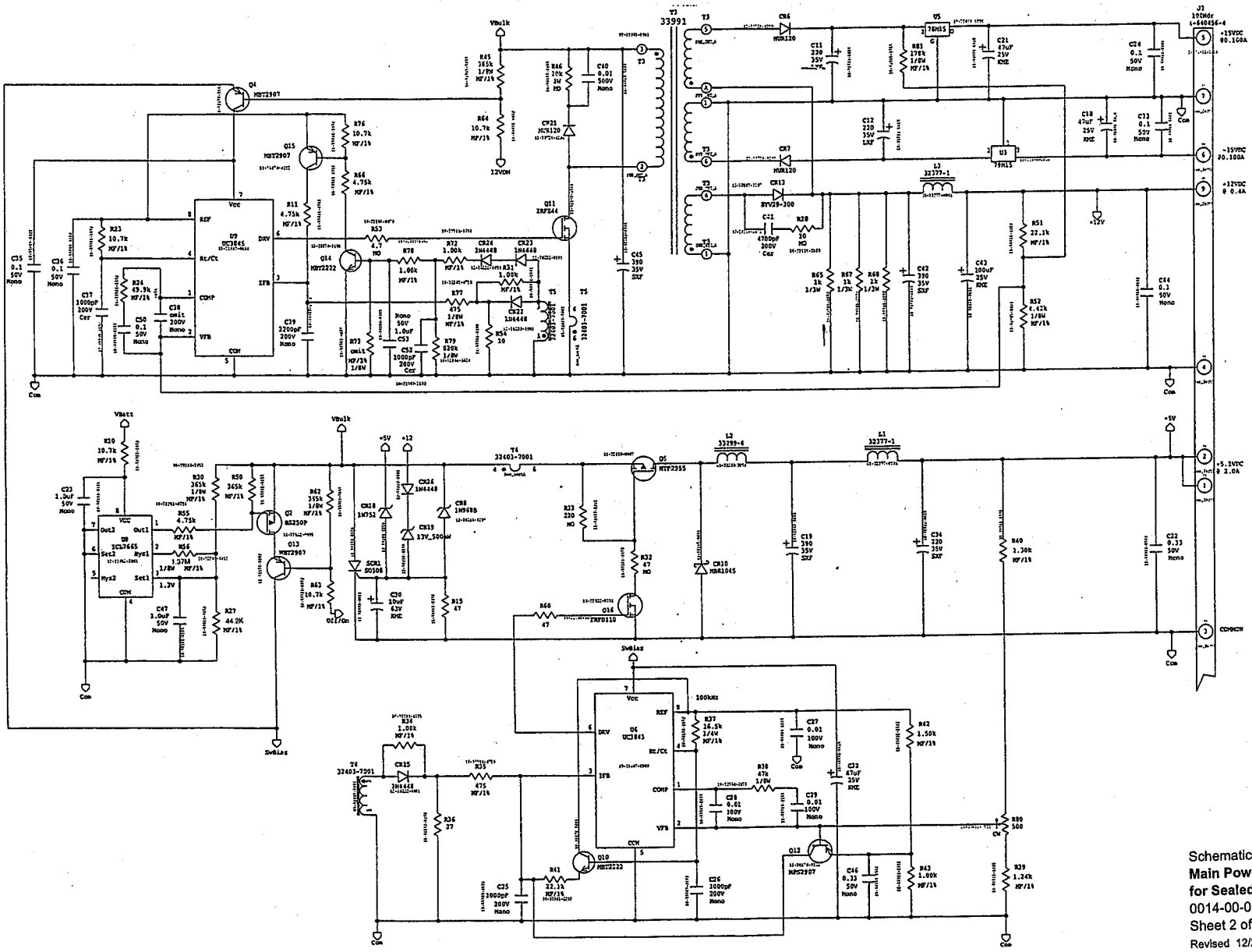
Communication Board
0670-00-0661
Revised 12/20/00



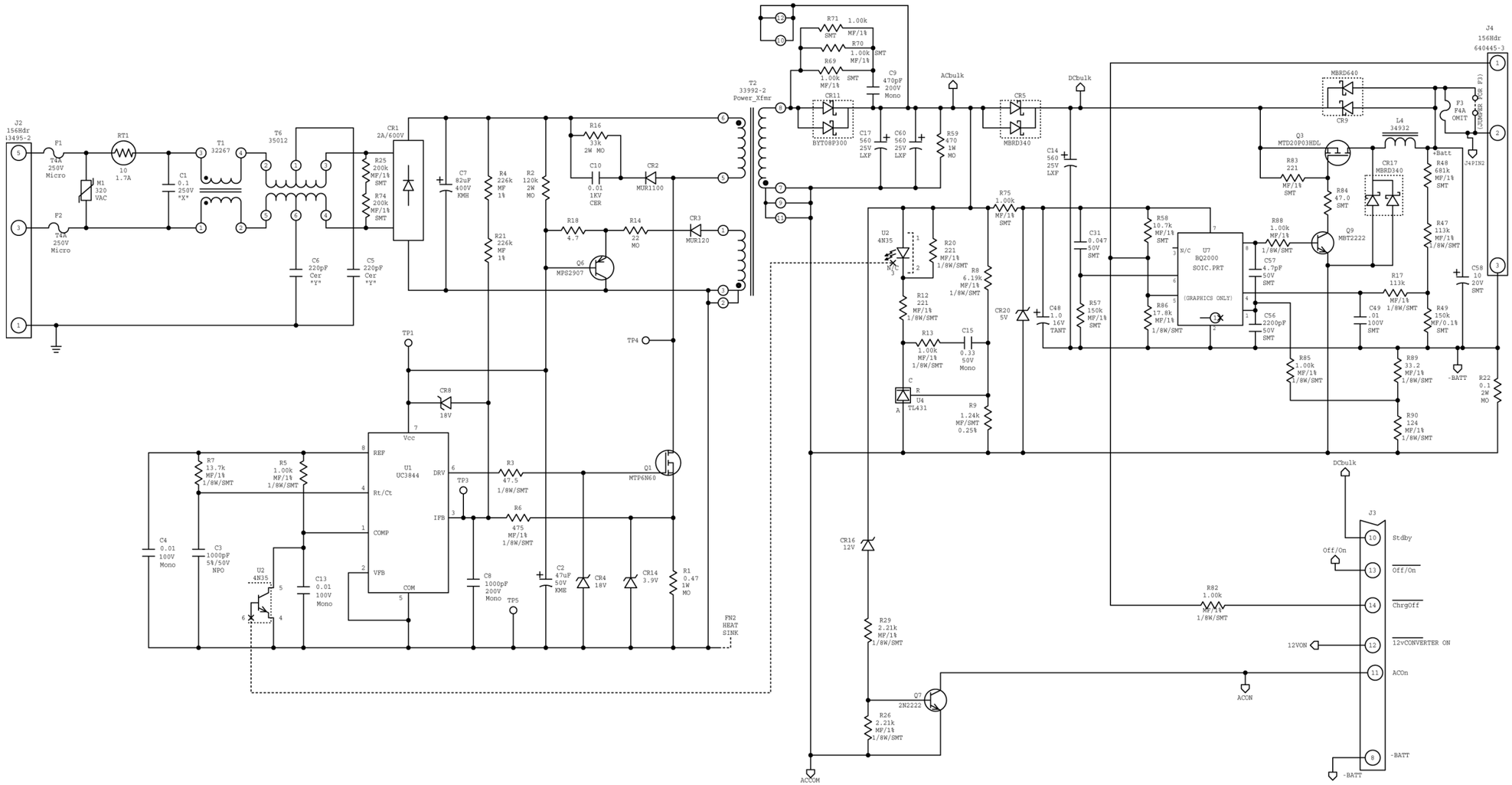
Schematic Diagram
Communication Board
0387-00-0661
Sheet 1 of 1
Revised 12/20/00



Schematic Diagram
Main Power Supply Board
for Sealed Lead Acid Battery
0014-00-0184
Sheet 1 of 2
Revised 12/20/00

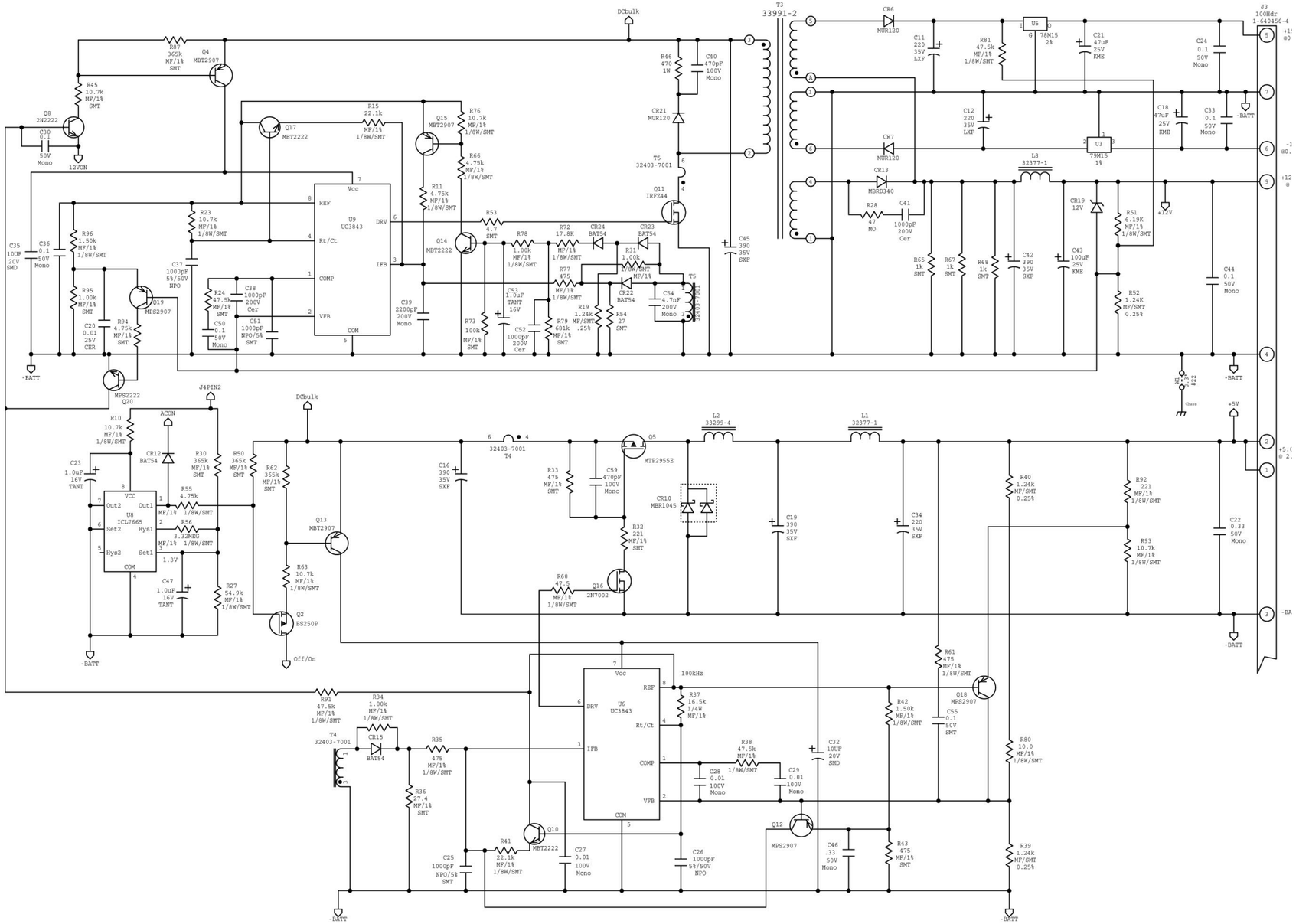


Schematic Diagram
Main Power Supply Board
for Sealed Lead Acid Battery
0014-00-0184
Sheet 2 of 2
Revised 12/20/00



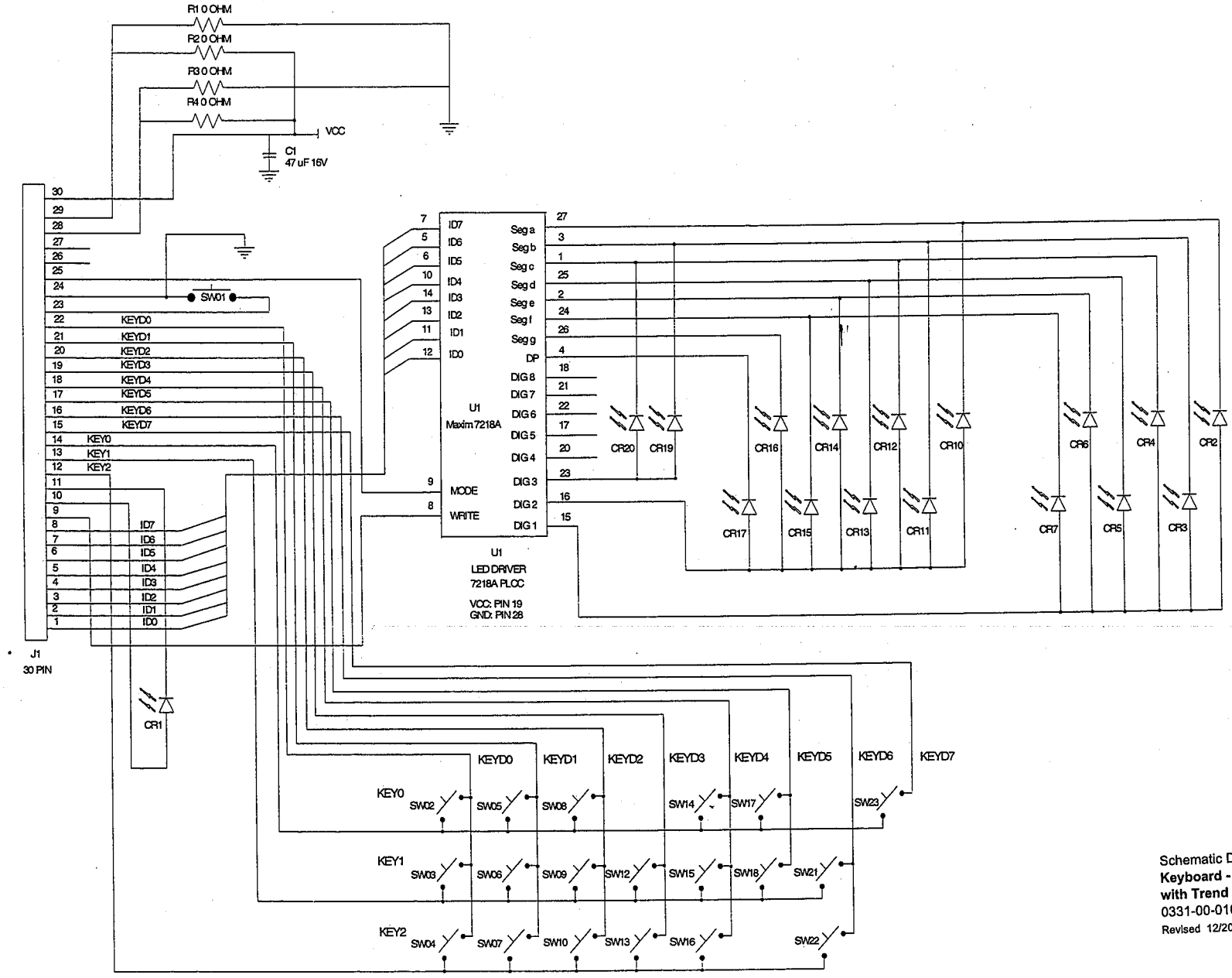
Schematic Drawing
Main Power Supply Board
for Lithium-Ion Battery
0014-00-0125

Page 1 of 2

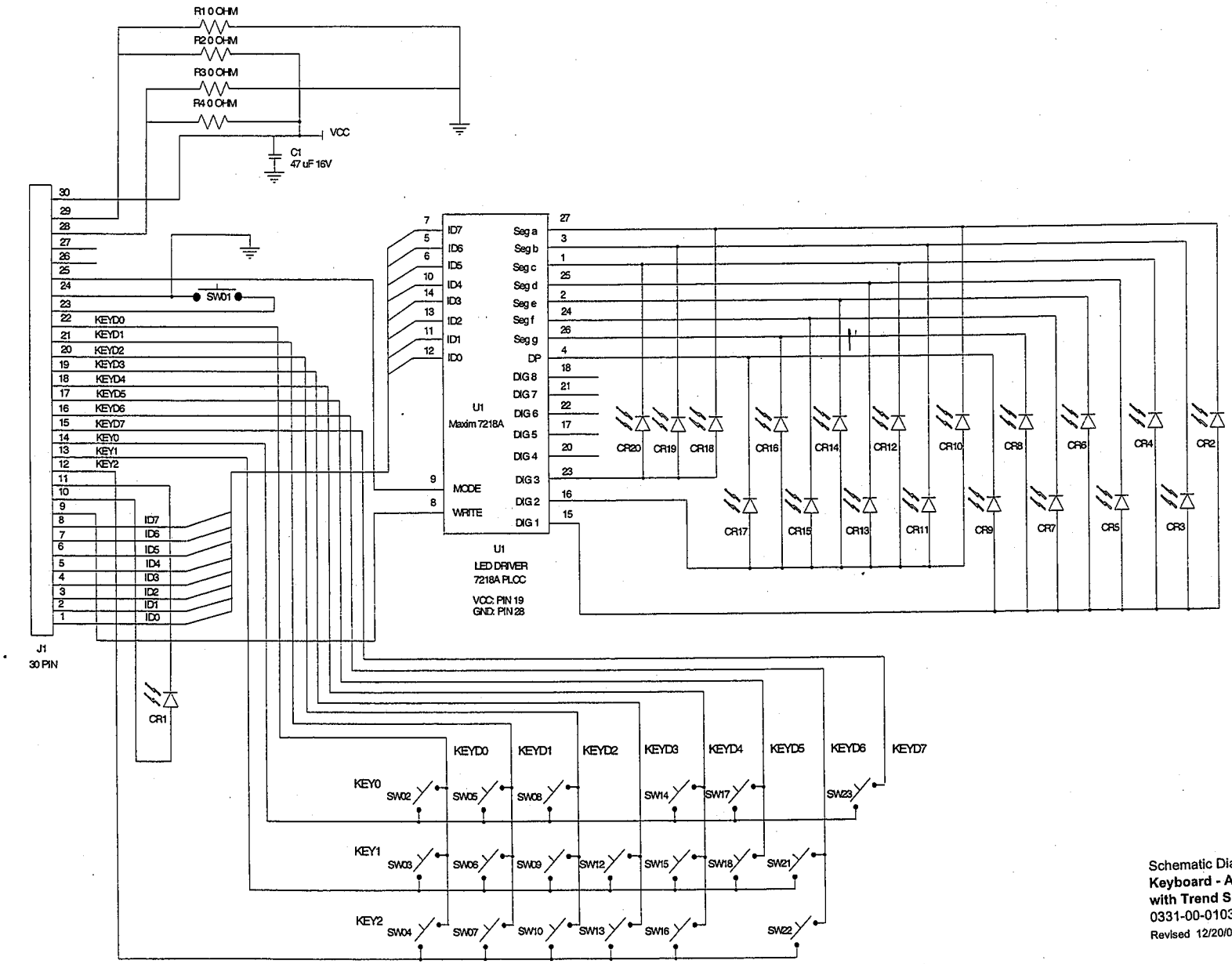


Schematic Drawing
Main Power Supply Board
for Lithium-Ion Battery
0014-00-0125

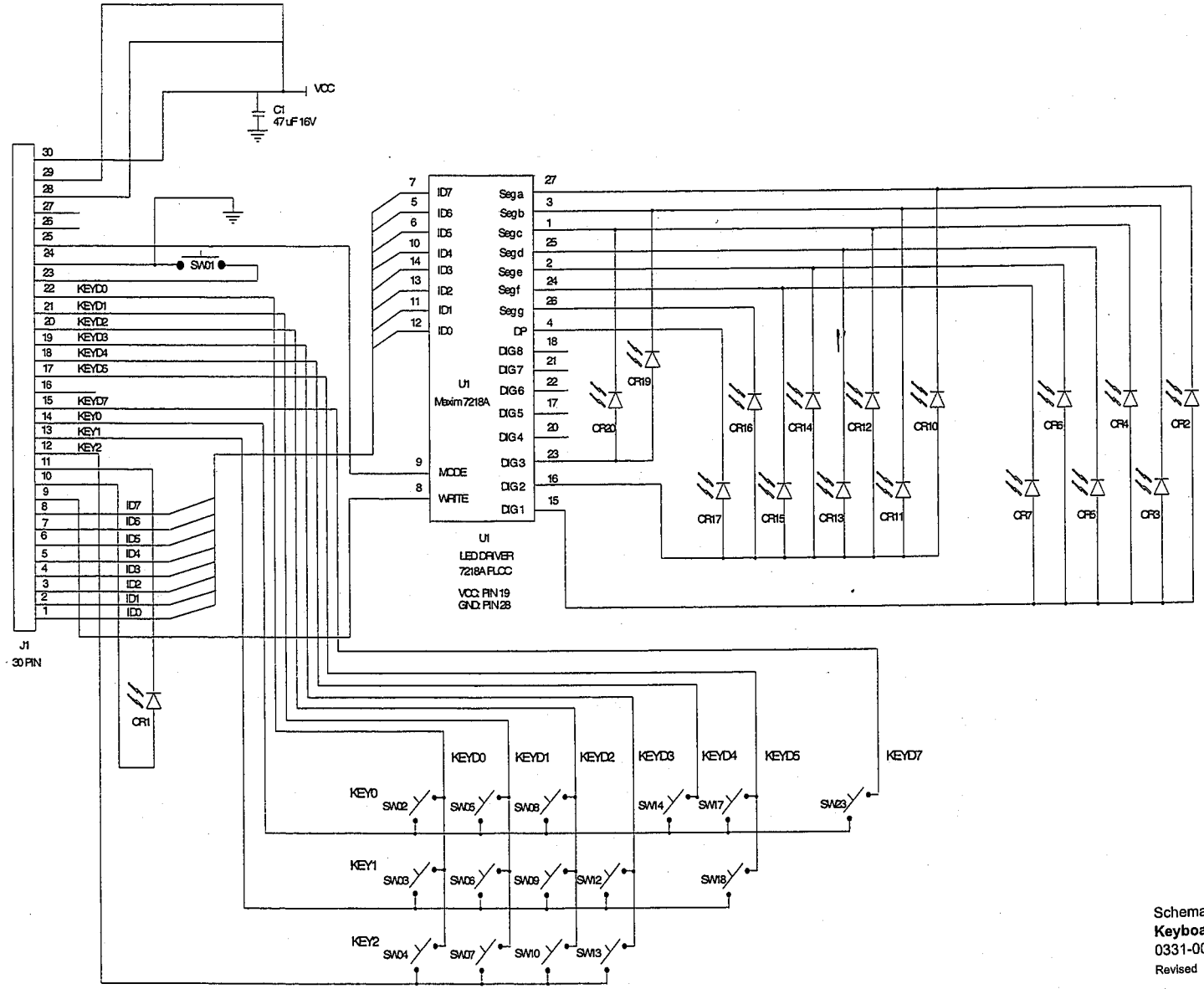
Page 2 of 2



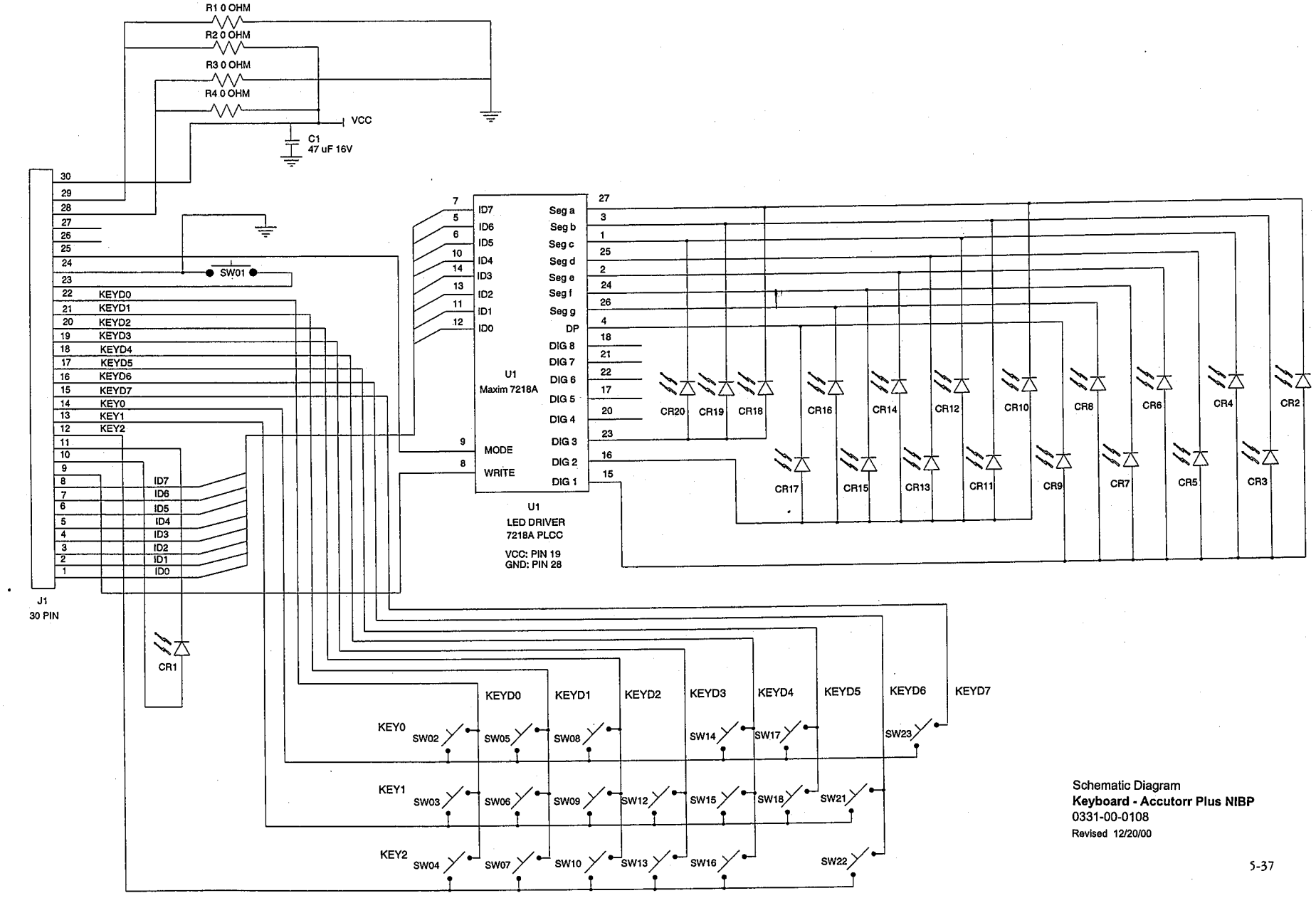
Schematic Diagram
Keyboard - Accutorr Plus NIBP with Trend Screen
0331-00-0102
Revised 12/20/00



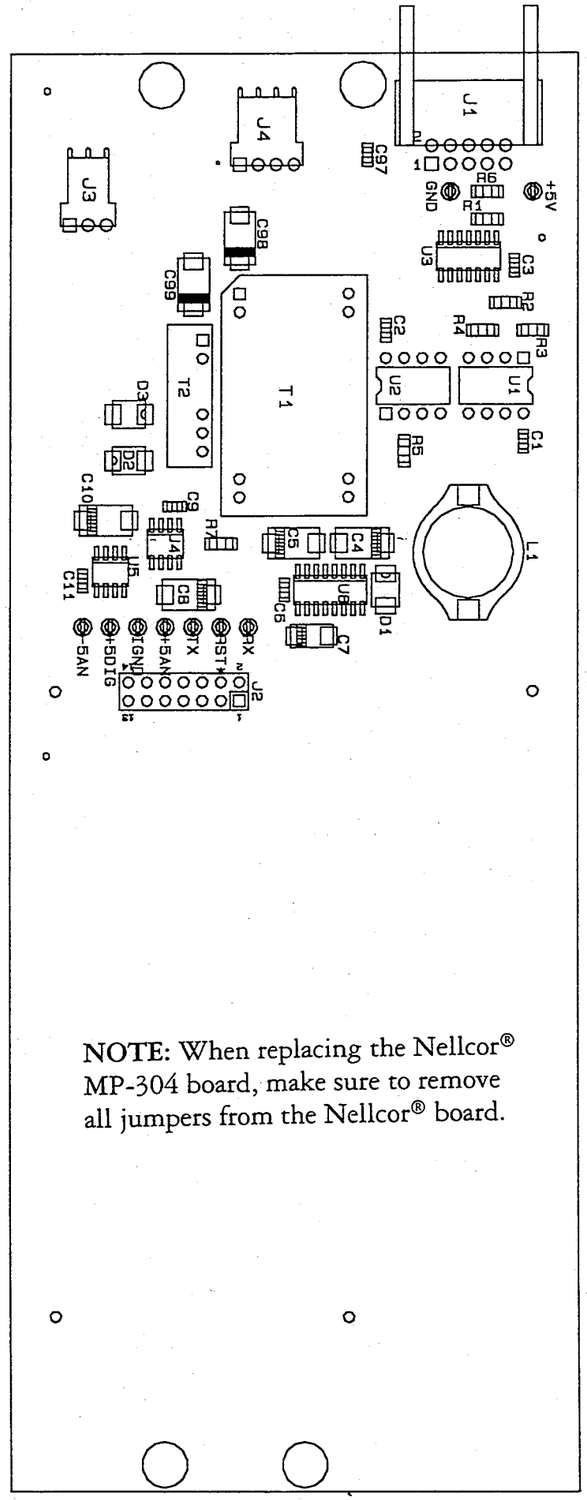
Schematic Diagram
Keyboard - Accutorr Plus NIBP with Trend Screen and SpO_2
0331-00-0103
Revised 12/20/00



Schematic Diagram
Keyboard - Accutorr Plus NIBP
0331-00-0104
Revised 12/20/00

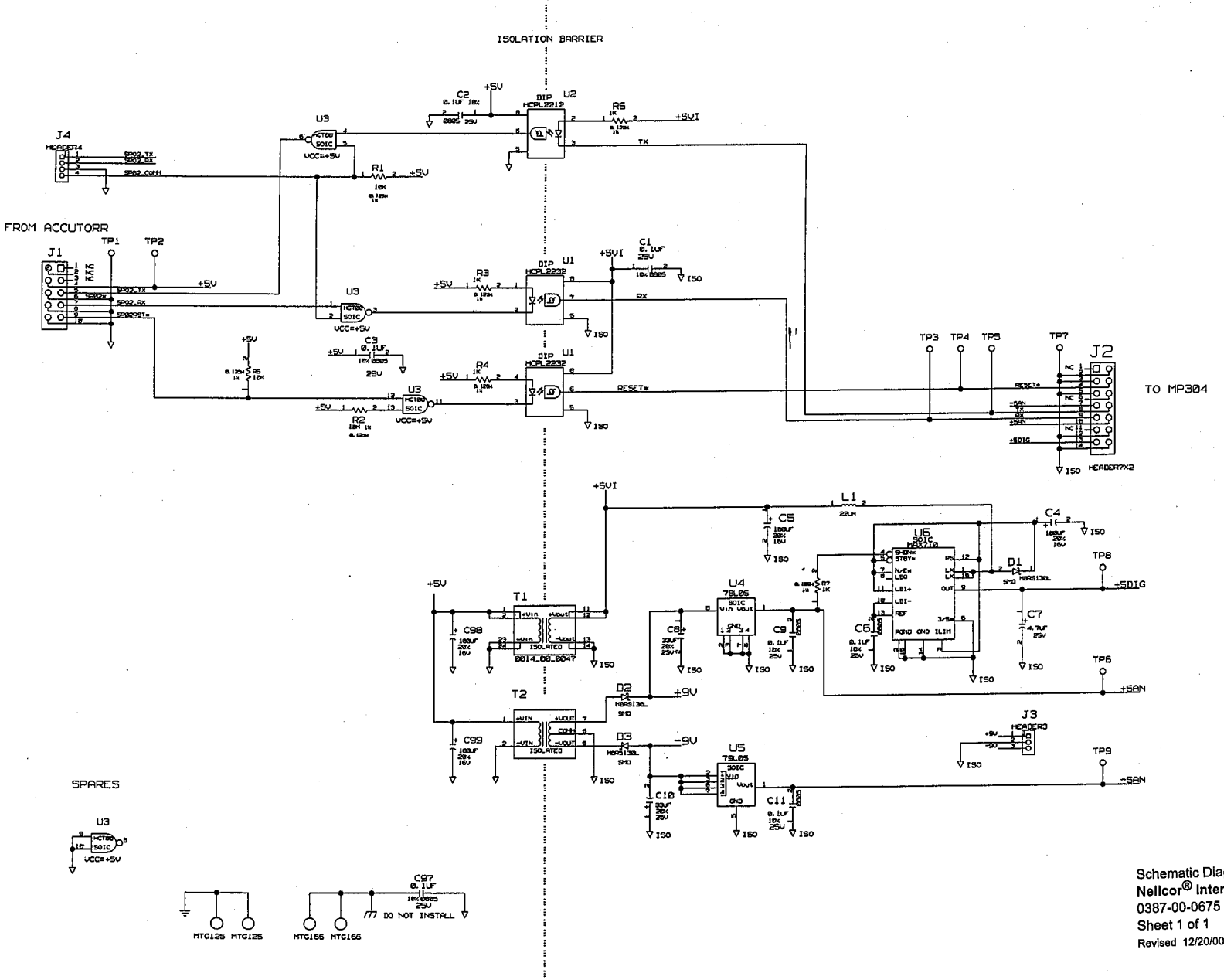


Schematic Diagram
Keyboard - Accutorr Plus NIBP
0331-00-0108
Revised 12/20/00

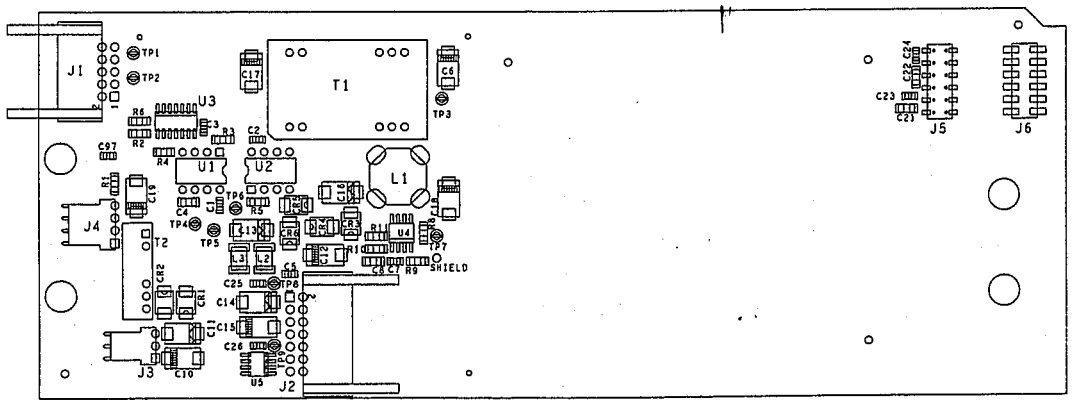


NOTE: When replacing the Nellcor® MP-304 board, make sure to remove all jumpers from the Nellcor® board.

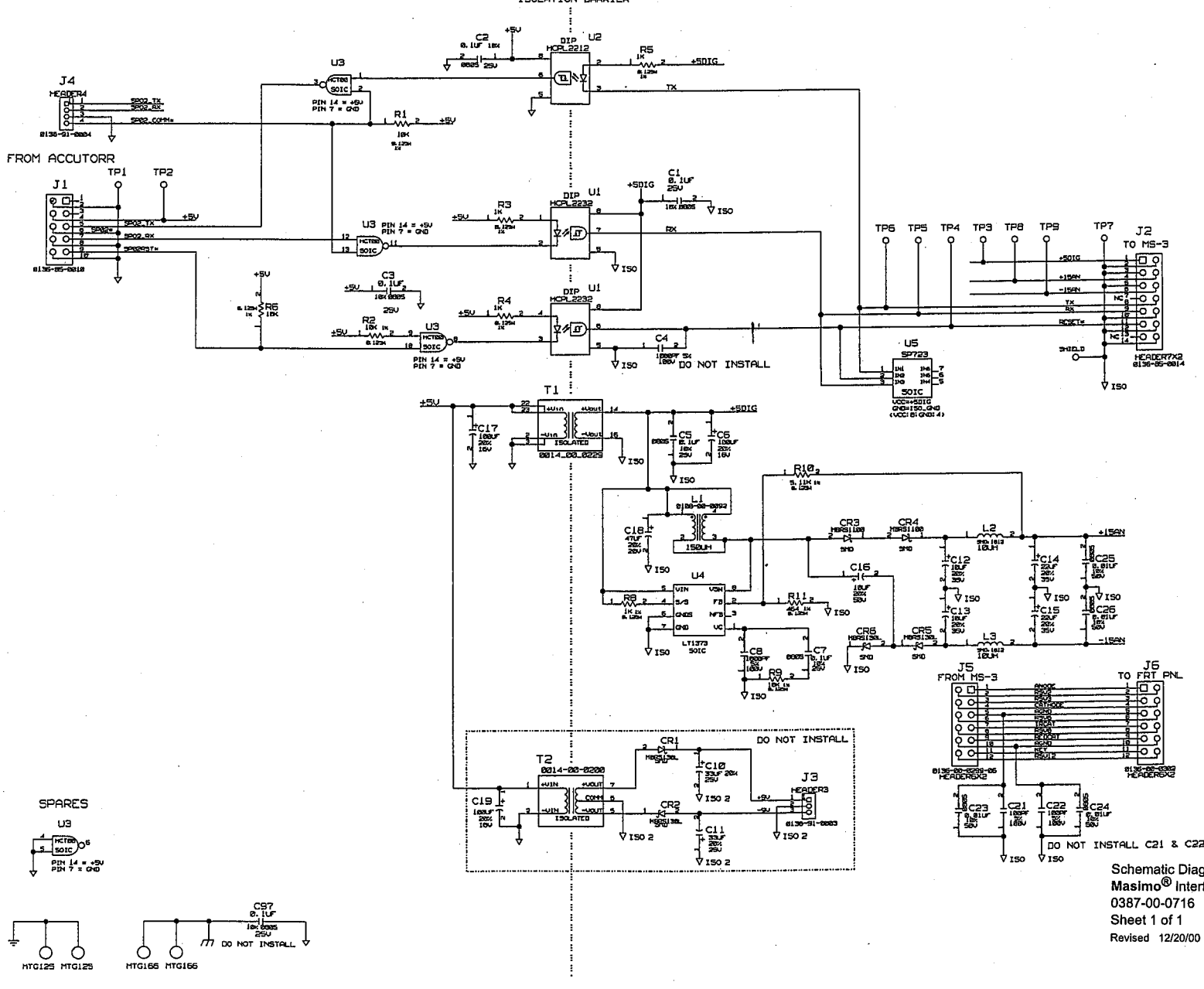
Nellcor® Interface PCB
0670-00-0675
Revised 12/20/00

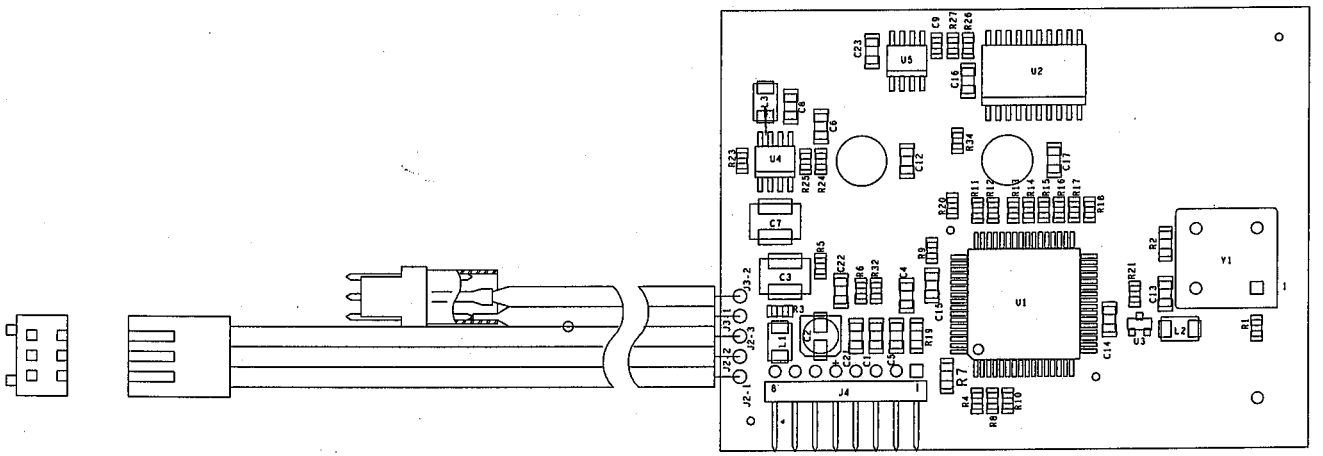


Schematic Diagram
Nellcor® Interface PCB
0387-00-0675
Sheet 1 of 1
Revised 12/20/00

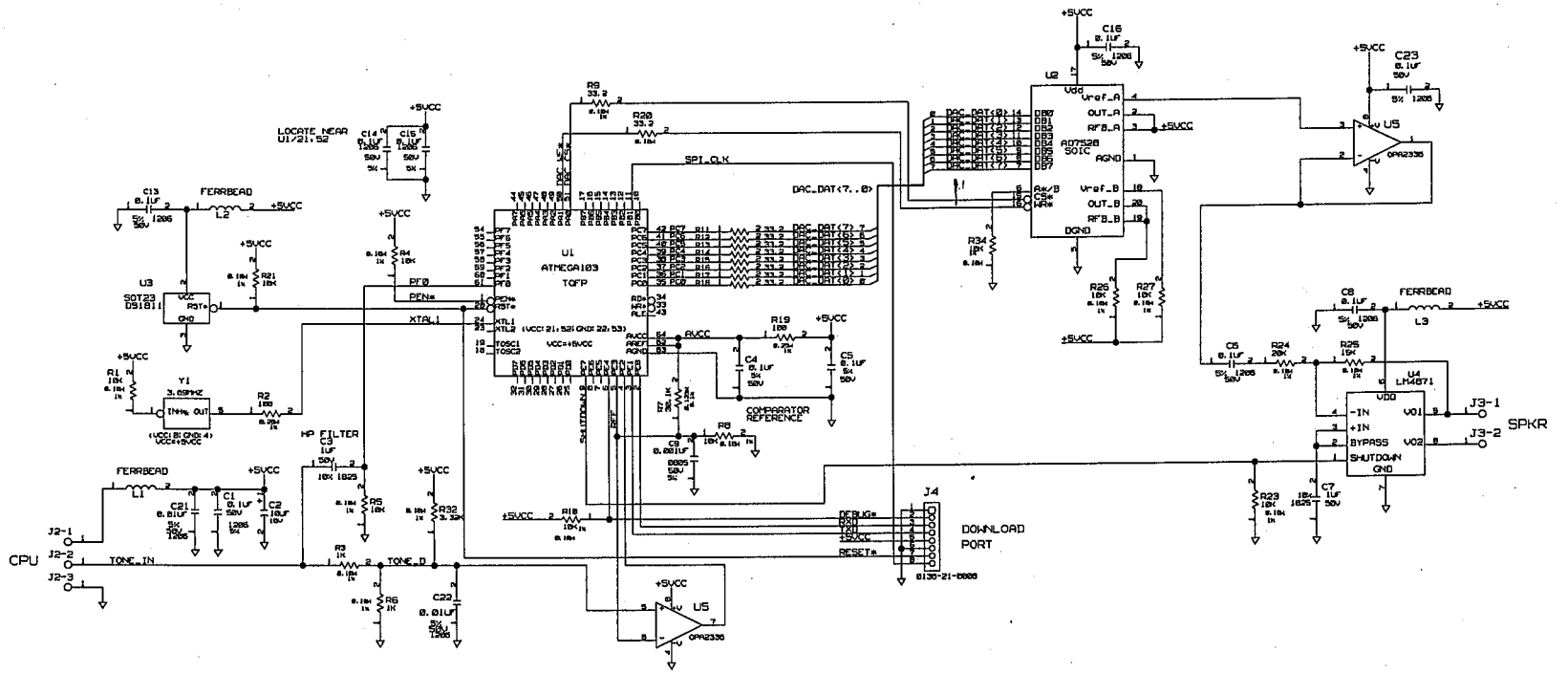


Masomo® Interface PCB
0670-00-0716
Revised 12/20/00

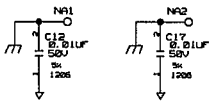

ISOLATION BARRIER
FROM ACCUTORR
J1
J4
HEADER4
TP1
TP2
U1
U2
U3
U4
U5
T1
T2
J2
TO MS-3
J3
J5
FROM MS-3
J6
TO FRT PNL
SP723
LT1373
DO NOT INSTALL
DO NOT INSTALL C21 & C22
SPARES
MTG125 MTG125
MTG166 MTG166
Schematic Diagram
Masimo® Interface PCB
0387-00-0716
Sheet 1 of 1
Revised 12/20/00



Tone Processor Board Layout
0670-00-1134
Revised 2/28/01



MOUNTING HOLES



Schematic Diagram
Tone Processor Board Layout
0387-00-1134
Revised 2/28/01

This page intentionally left blank.

This page intentionally left blank.

6.0 REPLACEMENT PARTS

CONTENTS OF THIS CHAPTER . . . . . **Page**

6.1 INTRODUCTION

This chapter of the Service Manual provides information necessary to identify the replacement parts and assemblies of the instrument.

6.2 AVAILABLE REPLACEMENT PARTS AND SUB-ASSEMBLIES

The parts listings which follow are divided into two sections. The Isometric Drawings and the accompanying parts lists identify the available chassis mounted components. A listing for the components on each circuit board then follows.

6.3 PRODUCT VARIATIONS AND OPTIONS

Product variations, due to differences for various line voltages, options and languages may require different components. These variations are reflected, where necessary, on the parts lists.

6.4 EXCHANGE PROGRAM

Datascope offers an exchange policy for most of the printed circuit board assemblies. This program may provide the most expedient method of servicing the equipment. A standard charge for this service is made. Contact the Datascope Service Department for details concerning this exchange program.

Many circuit boards make extensive use of multi-layer technology and high density packaging. Individual component replacement is not recommended on these boards unless the technician is properly equipped to repair multi-layer circuit boards.

Circuit boards, returned as parts of the exchange program, that show evidence of improper repair techniques and are damaged in the process are not considered for exchange. Damaged boards will be invoiced at full value and no exchange credit will be applied.

6.5 REPLACEMENT PARTS PRICING INFORMATION

Current parts prices and exchange charges can be determined by contacting Datascope, Order Entry Department.

6.6 ORDERING INFORMATION

Replacement parts and assemblies are available from Datascope Corp., and in Europe from Datascope B.V. Please follow these guidelines when ordering replacement items for the instrument.

1. Include the Model and Serial Number of the instrument.

2. Include the Datascope Part Number exactly as it appears in the Parts List under the column, "Datascope Part Number."

3. Include a description of the item.

EXAMPLE ORDERS: (1) ea. P/N 0014-00-0184
Main Power Supply Board
Serial No. XXXX-XX

(2) ea. P/N 0212-12-0404
Screw, #4-40 x .25 lg. Pan Head,
Serial No. XXXX-XX

NOTES:

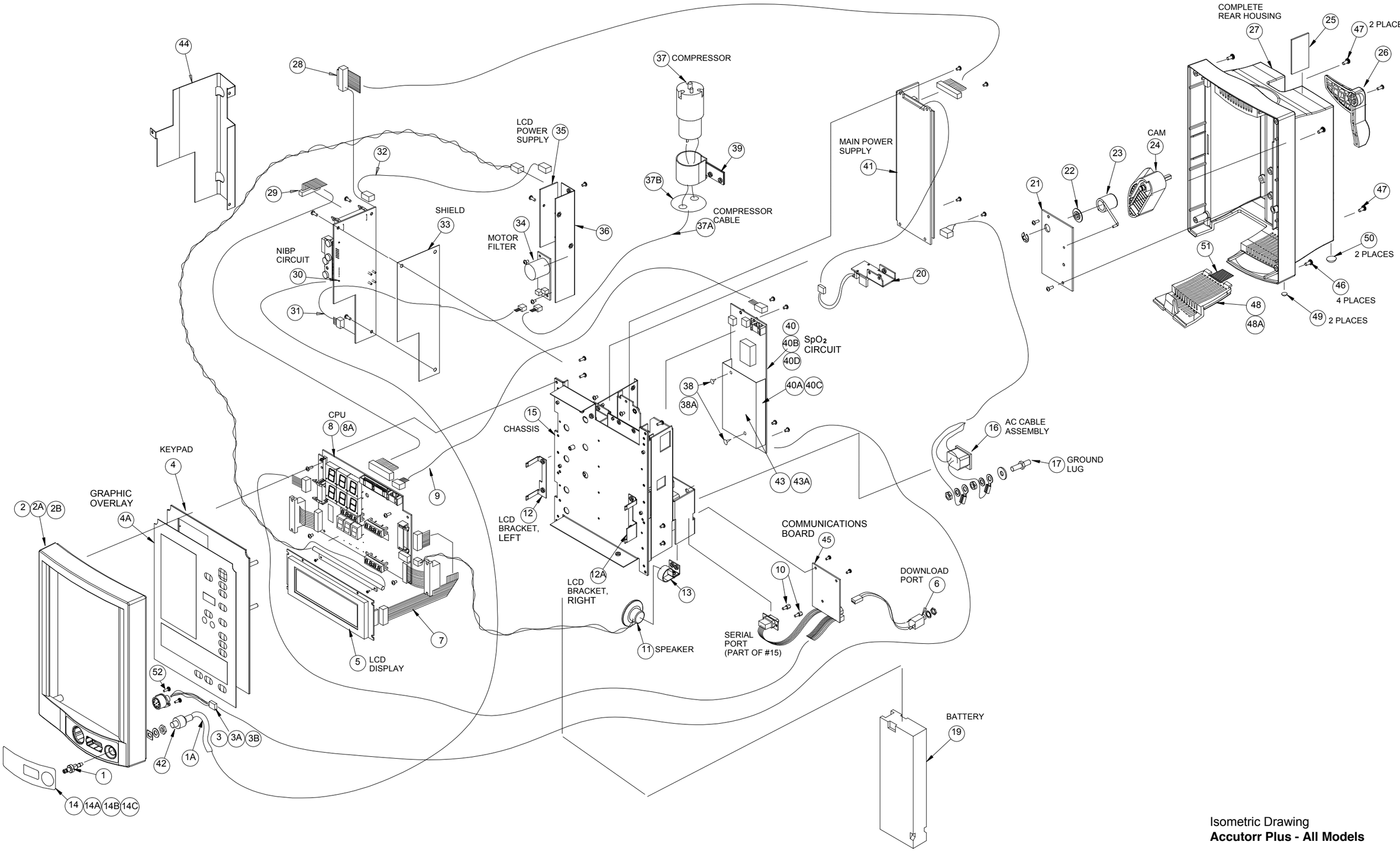
Datascope Corp. maintains a policy of continuous development for product improvement and reserves the right to change materials, specifications, and prices without notice.

Many components are described with sufficient detail to permit procurement through local commercial channels. This applies to hardware, such as screws and fasteners, as well as to certain electronic components, such as resistors, capacitors, certain integrated circuits and transistors. In some cases, components are selected by Datascope to meet special performance criteria above and beyond the component manufactures specifications. This may apply to solid state components, relays and batteries. The use of other than Datascope components in these applications may result in degradation of reliability or instrument performance.

6.7 ABBREVIATIONS

The following abbreviations may appear in the parts listings which follow and/or through the manual.

Abbreviation	Term	Abbreviation	Term
A/D	Analog to Digital	NTWK	Network
AMP	Amplifier		
		OP	Operational
BUF	Buffer		
		PB	Push Button
CAP	Capacitor	PIA	Peripheral Interface Adapter
ICC	Carbon Composition	POT	Potentiometer
CER	Ceramic	PRESS	Pressure]
CERM	Ceramic	PWR	Power
CNTR	Counter		
CONN	Connector	RAM	Random Access Memory
CONT	Controller	REC	Receiver
CONV	Converter	RECT	Rectangular
CPU	Central Processing Unit	REG	Regulated RES Resistor
		SLA	Sealed Lead Acid
DCDR	Decoder	STG	Stage
DIFF	Differential	STK	Stacked
DIA	Diastolic	SUP	Supply
DIO	Diode	SW	Switch
D/A	Digital to Analog	SYST	Systolic
ELEC	Electrolytic	TANT	Tantalum
EPROM	Erasable Programmable Read Only Memory	TRANS	Transistor
		TRANSIS	Transistor
FXD	Fixed	VAR	Variable
		VIA	Versatile Interface Adapter
I.C.	Integrated Circ		
INT. CKT.	Integrated Circuit		
KYBD	Keyboard	XDCR	Transducer
		XFMR	Transformer
LED	Light Emitting Diode	XSTL	Crystal
Li-Ion	Lithium Ion	XSTR	Transistor
MF	Metal Film		
MONO	Monostable		
MYLR	Mylar		



Isometric Drawing
Accutorr Plus - All Models

6.8 ISOMETRIC DRAWINGS AND PARTS LIST

6.8.1. Accutorr Plus Isometric Parts List (All Models)

Figure No.	Description	Datascope Part Number
1	Pressure fitting	0103-00-0411
1a	Tubing, 13" (front panel to NIBP module)	0008-10-0408
2	Bezel, front, Datascope ONLY	0380-00-0359-04
2a	Bezel, front, NELLCOR® or Datascope	0380-00-0359-05
2b	Bezel, front, MASIMO® Only	0380-00-0359-06
3	SpO_2 connector assembly Datascope	0012-00-1223
3a	SpO_2 connector assembly NELLCOR®	0012-00-1222-01
3b	SpO_2 connector assembly MASIMO®	0012-00-1344
4	Keypad, without graphic panels	See Table.
4a	Graphic panels	See Table.
5	LCD display with backlite	0160-00-0034
6	Interface cable, download, phone jack	0012-00-1089
7	Interface cable for LCD	0012-00-1085
8	CPU circuit board (with SpO_2)	0670-00-0650-03
8a	CPU circuit board (without SpO_2)	0670-00-0650-04
9	Interface cable (SpO_2 to CPU)	0012-00-1238
10	Mounting screws for 9 pin Interface connector	0361-00-0164
11	Speaker with cable	0012-00-0257-05
12	LCD support brackets, left	0406-00-0756
12a	LCD support brackets, right	0406-00-0755
13	Speaker retainer bracket	0343-00-0097
14	Label, front bezel, no SpO_2 option	0334-00-1509-01
14a	Label, front bezel, w / DSCP SpO_2	0334-00-1509-02
14b	Label, front bezel, w / NELLCOR® SpO_2	0334-00-1509-03
14c	Label, front bezel, w / MASIMO® SpO_2	0334-00-1509-04
15	Chassis	0441-00-0103
16	AC (mains) power inlet w/cable	0012-00-0941
17	Ground lug	0124-00-0104-06
18	not used	
19	Battery, sealed lead acid	0146-00-0043
19a	Battery, Li-Ion	0146-00-0069
20	Battery connector with cable, SLA	0406-00-0754
20a	Battery connector with cable, Li-Ion	0997-00-0944
21	Cover plate, cam latch	0386-00-0212

Figure No.	Description	Datascope Part Number
22	Washer, shoulder, cam latch	0221-00-0139
23	Spring, torsion, cam latch	0214-00-0229
24	Cam latch with rubber friction tape	0380-00-0267
25	Friction strip, adhesive	0215-00-0107
26	Release handle	0380-00-0268
27	Rear housing complete with # 21-26	0380-00-0357-02
28	Interface cable, NIBP to power supply	0012-00-0943
29	Interface cable, NIBP to CPU	0012-00-0944
30	NIBP circuit module	0670-00-0584-02
31	Interface cable, NIBP to Filter PCB	0012-00-0986
32	Interface cable, NIBP to LCD Power Supply	0012-00-0989
33	Shield, plastic for NIBP	0349-00-0265
34	Motor filter circuit board	0670-00-0584-03
35	Inverter circuit for LCD backlite	0670-00-0649
36	Bracket, for Inverter and Motor filter	0406-00-0671
37	Compressor for NIBP, 12 VDC	0104-00-0008
37a	Cable for pump with quick connect term.	0012-00-1015
37b	Insulator, NIBP connector	0349-00-0314
38	Plastic push fasteners for SpO_2 shield	0344-00-0242
38a	Plastic fasteners for Masimo shield	0344-00-0249
39	Bracket for NIBP pump	0343-00-0098
40	SpO_2 circuit board, Datascope	0670-00-0593-03
40a	SpO_2 circuit board, NELLCOR®	0671-00-0162
40b	Interface board for NELLCOR® SpO_2	0670-00-0675
40c	SpO2 circuit board, Masimo®	0671-00-0055
40d	Interface board for Masimo® SpO_2	0670-00-0716
41	Power supply / batt. charger, sealed lead acid	0014-00-0184
41a	Power supply / batt. Charger, Li-Ion	0014-00-0225
42	Insulator tubing, PVC, .75"	0008-00-0324
43	SpO2 board shield, NELLCOR®	0349-00-0306
43a	SpO2 board shield, Masimo®	0337-00-0134
44	Shield, metal for NIBP module	0337-00-0120
45	Communication circuit board	0670-00-0661-01
46	Screw for rear housing (4-40 x 1.25")	0212-12-0420
47	Screw for rear housing (6-32 x .313")	0212-12-0605
48	Battery door, with plastic hinge	0380-00-0358-02
48a	Battery door, replacement only	0380-00-0358-01

Figure No.	Description	Datascope Part Number
49	Rubber feet, small	0348-00-0191-02
50	Rubber feet, large	0348-00-0191-01
51	Plastic hinge for batt. door, replacement only	0346-00-0043
52	Front bezel SpO_2 connector screws for Datascope SpO_2	0213-09-0405
53	Tone Processor Board	0670-00-1134
54	Luer Plate	0386-00-0162
55	Internal Tooth Lock Washer	0210-09-0025
56	Hex Nut	0220-00-0004
n/s	Label, rear panel, (large label with finger caution symbol)	334-00-1510
n/s	Label, Agency approvals and serial number	0334-00-1362- 03
n/s	Cable, Interface board to Masimo board	0012-00-1338
n/s	Nylon screws, Masimo board to Interface board	0212-01-0404
n/s	Front bezel SpO_2 connector screws for Nellcor and Masimo	0211-00-0140

FRONT PANEL KEYBOARDS AND GRAPHIC PANELS SELECTION

NOTE: When replacing a Keyboard, you must replace the Graphic Panel. Select correct parts combinations based on unit configuration. ie: 0998-00-0444-51 Order 0331-00-0103 keyboard and 0330-00-0027-01 Graphic Panel.

NOTE: Unit configurations that contain an L, indicate that unit contains a Lithium-Ion Battery.

Monitors with or without Datascope SpO_2			
Monitor Configuration	**Monitor Part Number**	**Keypad Part Number**	**Graphic Panel Part Number**
NIBP, Trend LCD, DSCP SpO_2 (USA, IEC, English)	0998-00-0444-51 0998-00-0444-L51	0331-00-0103	0330-00-0027-01
NIBP, Trend LCD (USA, IEC, English)	0998-00-0444-41 0998-00-0444-L41	0331-00-0102	0330-00-0026-01
NIBP only (USA, IEC, English)	0998-00-0444-31 0998-000444-L31	0331-00-0104	0330-00-0025-01
NIBP, Trend LCD, DSCP SpO_2 (IEC, German)	0998-00-0444-52 0998-00-0444-L52	0331-00-0103	0330-00-0027-02
NIBP, Trend LCD (IEC, German)	0998-00-0444-42 0998-00-0444-L42	0331-00-0102	0330-00-0026-02
NIBP only (IEC, German)	0998-00-0444-32 0998-00-0444-L32	0331-00-0104	0330-00-0025-02
NIBP, Trend LCD, DSCP SpO_2 (IEC, Spanish)	0998-00-0444-53 0998-00-0444-L53	0331-00-0103	0330-00-0027-03
NIBP, Trend LCD (IEC,Spanish)	0998-00-0444- 43 0998-00-0444-L43	0331-00-0102	0330-00-0026-03
NIBP only (IEC, Spanish)	0998-00-0444- 33 0998-00-0444-L33	0331-00-0104	0330-00-0025-03
NIBP, Trend LCD, DSCP SpO_2 (IEC, French)	0998-00-0444-54 0998-00-0444-L54	0331-00-0103	0330-00-0027-04
NIBP, Trend LCD (IEC, French)	0998-00-0444- 44 0998-00-0444-L44	0331-00-0102	0330-00-0026-04
NIBP only (IEC, French)	0998-00-0444- 34 0998-00-0444-L34	0331-00-0104	0330-00-0025-04
NIBP, Trend LCD, DSCP SpO_2 (IEC, Italian)	0998-00-0444- 56 0998-00-0444-L56	0331-00-0103	0330-00-0027-06
NIBP, Trend LCD (IEC,Italian)	0998-00-0444- 46 0998-00-0444-L46	0331-00-0102	0330-00-0026-06
NIBP only (IEC, Italian)	0998-00-0444- 36 0998-00-0444-L36	0331-00-0104	0330-00-0025-06
NIBP, Trend LCD, DSCP SpO_2 (IEC, Swedish)	0998-00-0444- 57 0998-00-0444-L57	0331-00-0103	0330-00-0027-07
NIBP, Trend LCD (IEC, Swedish)	0998-00-0444- 47 0998-00-0444-L47	0331-00-0102	0330-00-0026-07
NIBP only (IEC, Swedish)	0998-00-0444- 37 0998-00-0444-L37	0331-00-0104	0330-00-0025-07

With NELLCOR SpO_2 only			
Monitor Configuration	**Monitor Part Number**	**Keypad Part Number**	**Graphic Panel Part Number**
NIBP, Trend LCD DSCP SpO_2 (IEC, English)	0998-00-0444-55 0998-00-0444-L55	0331-00-0103	0330-00-0027-01
NIBP, Trend LCD (IEC, English)	0998-00-0444-45 0998-00-0444-L45	0331-00-0102	0330-00-0026-01
NIBP Only, (IEC, English)	0998-00-0444-35 0998-00-0444-L35	0331-00-0104	0330-00-0025-01
NIBP, Trend LCD, NELLCOR SpO2 (USA, IEC, English)	0998-00-0444-61 0998-00-0444-L61	0331-00-0108	0330-00-0027-01
NIBP, Trend LCD, NELLCOR SpO_2 (IEC, German)	0998-00-0444-62 0998-00-0444-L62	0331-00-0108	0330-00-0027-02
NIBP, Trend LCD, NELLCOR SpO_2 (IEC, Spanish)	0998-00-0444-63 0998-00-0444-L63	0331-00-0108	0330-00-0027-03
NIBP, Trend LCD, NELLCOR SpO_2 (IEC, French)	0998-00-0444-64 0998-00-0444-L64	0331-00-0108	0330-00-0027-04
NIBP, Trend LCD, NELLCOR SpO_2 (IEC, Italian)	0998-00-0444-66 0998-00-0444-L66	0331-00-0108	0330-00-0027-06
NIBP, Trend LCD, NELLCOR SpO_2 (IEC, Swedish)	0998-00-0444-67 0998-00-0444-L67	0331-00-0108	0330-00-0027-07
NIBP Trend LCD Nellcor SpO_2 (IEC, English)	0998-00-0444-65 0998-00-0444-L65	0331-00-0108	0330-00-0027-01

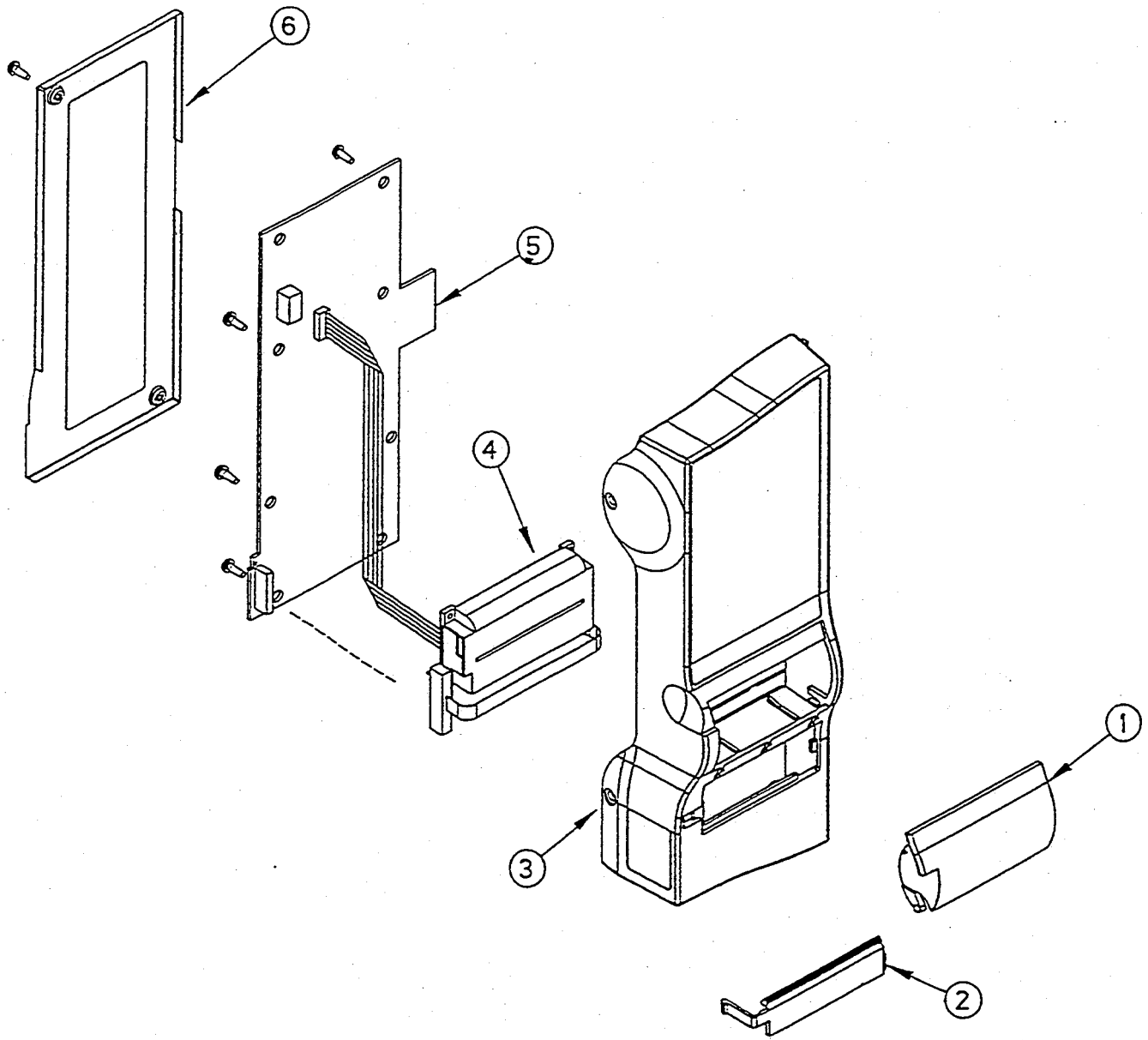
Table 6-1a - Keypad and Graphic Overlay Part Numbers, NELLC0R

With Masimo SpO_2 only			
Monitor Configuration	**Monitor Part Number**	**Keypad Part Number**	**Graphic Panel Part Number**
NIBP, Trend LCD, Masimo SpO_2 (USA, IEC, English)	0998-00-0444-71 0998-00-0444-L71	0331-00-0108	0330-00-0027-01
NIBP, Trend LCD, Masimo SpO_2 (IEC, German)	0998-00-0444-72 0998-00-0444-L72	0331-00-0108	0330-00-0027-02
NIBP, Trend LCD, Masimo SpO_2 (IEC, Spanish)	0998-00-0444-73 0998-00-0444-L73	0331-00-0108	0330-00-0027-03
NIBP, Trend LCD, Masimo SpO_2 (IEC, French)	0998-00-0444-74 0998-00-01444-L74	0331-00-0108	0330-00-0027-04
NIBP, Trend LCD, Masimo SpO_2 (IEC, Italian)	0998-00-0444-76 0998-00-0444-L76	0331-00-0108	0330-00-0027-06

With Masimo SpO_2 only			
Monitor Configuration	**Monitor Part Number**	**Keypad Part Number**	**Graphic Panel Part Number**
NIBP, Trend LCD Masimo SpO_2 (IEC, English)	0998-00-0444-75 0998-00-0444-L75	0331-00-01058	0330-00-0027-01
NIBP, Trend LCD, Masimo SpO_2 (IEC, Swedish)	0998-00-0444-77	0331-00-0108	0330-00-0027-07

Table 6-1b - Keypad and Graphic Overlay Part Numbers, Masimo

This page intentionally left blank.

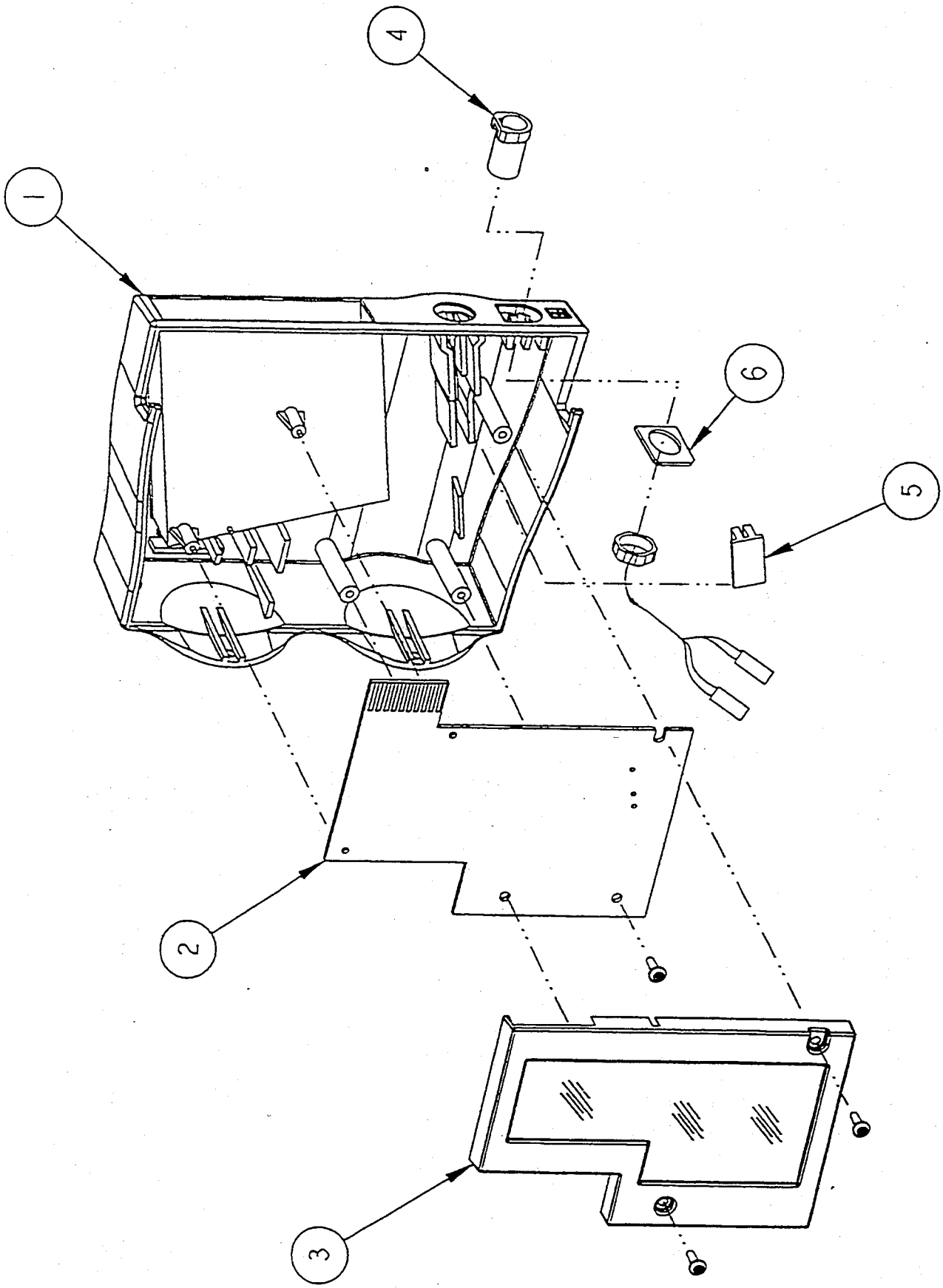


Isometric Drawing
RECORDER MODULE

6.8.2 Recorder Module Isometric Parts List

Figure No.	Description	Datascope Part Number
1	Chart Paper Door	0380-00-0274
2	Chart Cutter	0380-00-0275
3	Recorder Main Housing	0380-00-0273-01
4	Printer Assembly w/printhead	0161-00-0015
5	Circuit Board, Includes Printer	0670-00-0583-01
6	Plastic Shield, Anti Static	0349-00-0251
N/S*	Label, Serial Number	0334-00-1304
N/S*	Label, Recorder Paper Replacement	0334-00-1435
N/S*	Captive Screw for Mounting	0217-02-0003
N/S*	Captive Washer for Above	0221-00-0121

*N/S are items not shown on drawing.

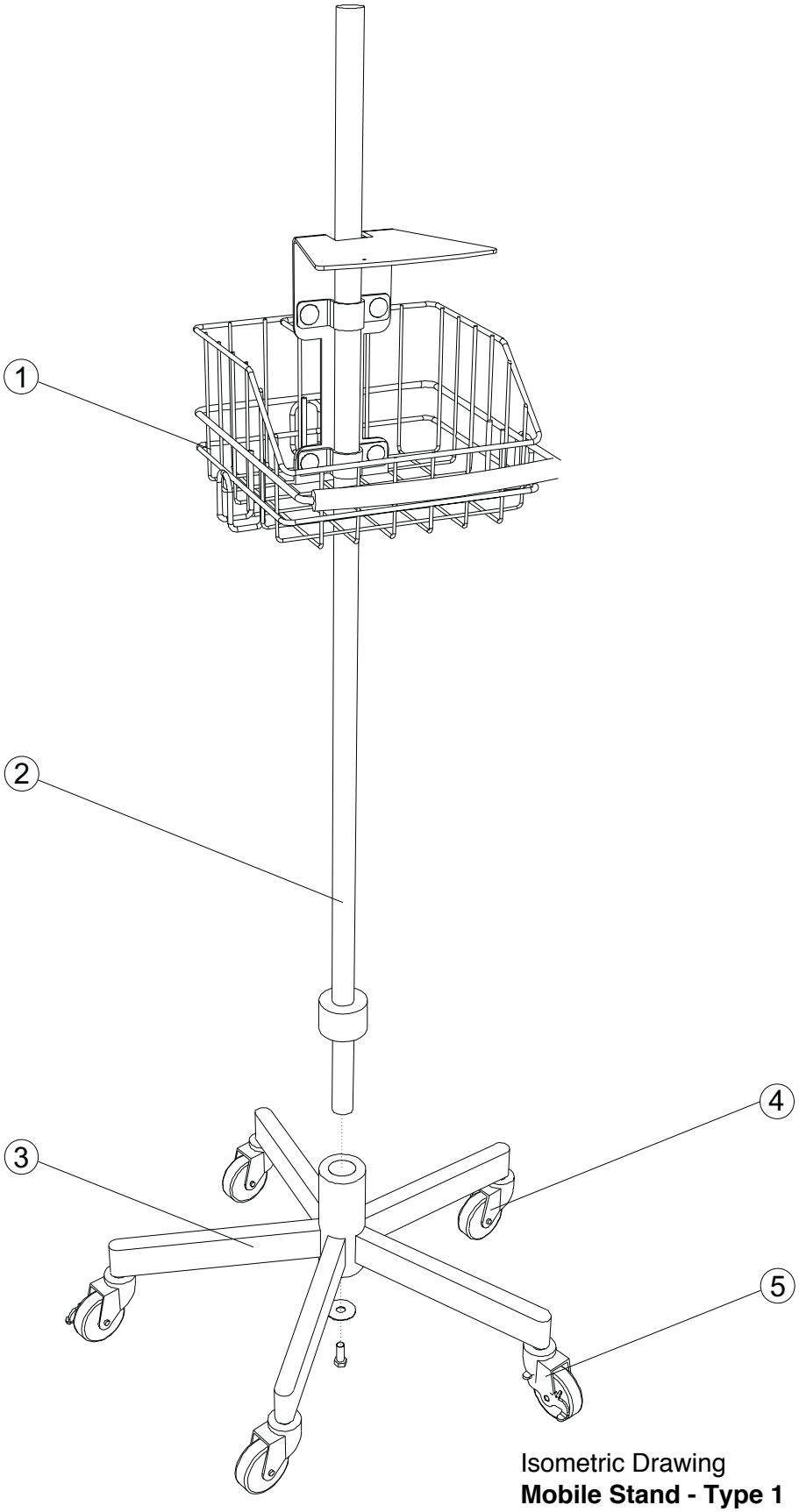


Isometric Drawing
Predictive
Temperataure Module

6.8.3 Predictive Temperature Module Isometric Parts List

Figure No.	Description	Datascope Part Number
1	Housing	0380-00-0271
2	Circuit Board	0670-00-0582
3	Anti Static Shield	0349-00-0251
4	Connector Assembly (with 9V battery)	0012-00-0953
4a	Connector Assembly (without 9V battery)	0012-00-1335
5	Spacer, Probe	0432-00-0008
6	Washer, Flat	0221-00-0140
N/S*	Captive Screw for Mounting	0217-02-0003
N/S*	Captive Washer for Above	0221-00-0121

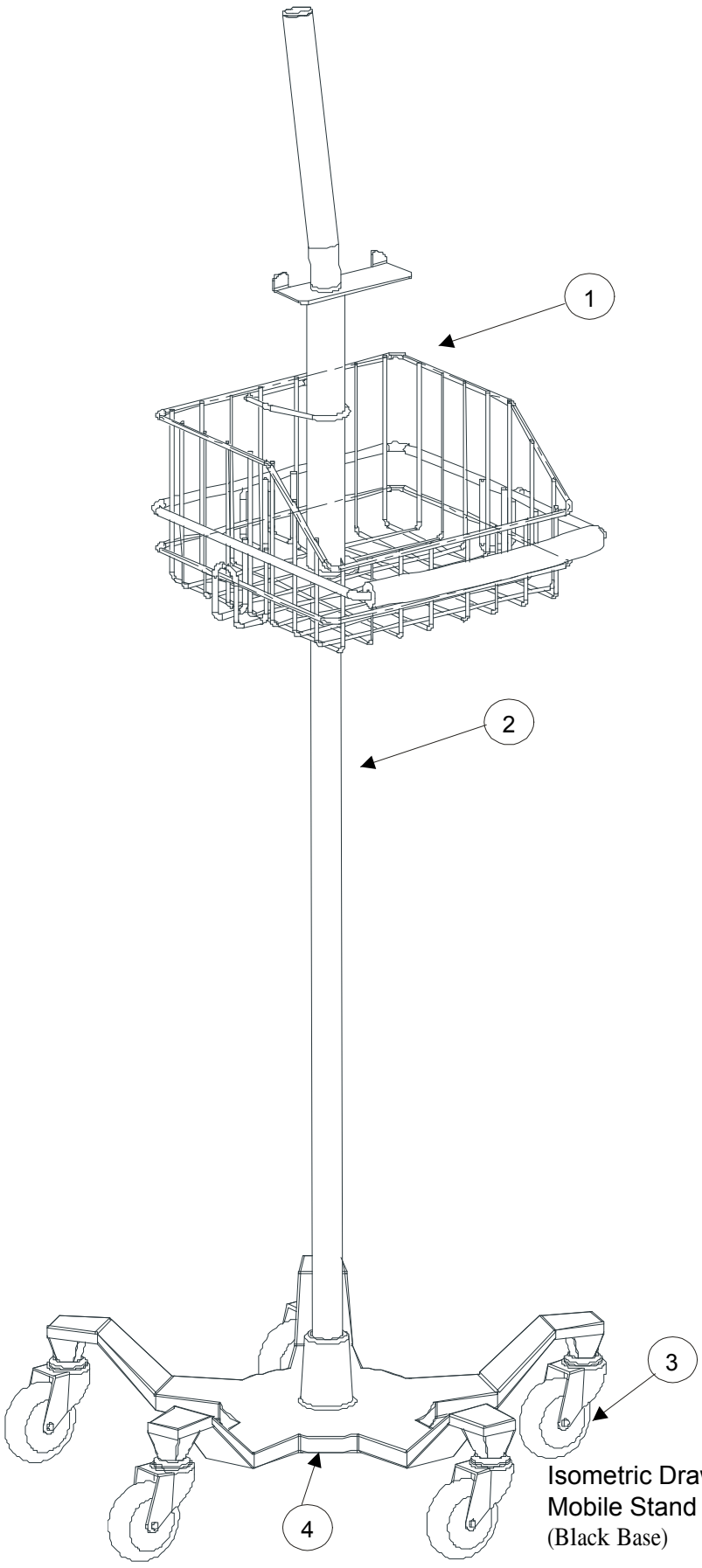
* Not shown



Isometric Drawing
Mobile Stand - Type 1
(Gray Base)

6.8.4 Mobile Stand Type 1 (Gray Base) Assembly Parts List

Figure No.	Description	Datascope Part Number
1	Basket	0436-00-0100
2	Pole Assembly	0436-00-0099
3	Base	0436-00-0098
4	Caster	0401-00-0023-01
5	Caster, Locking	0401-00-0023-02

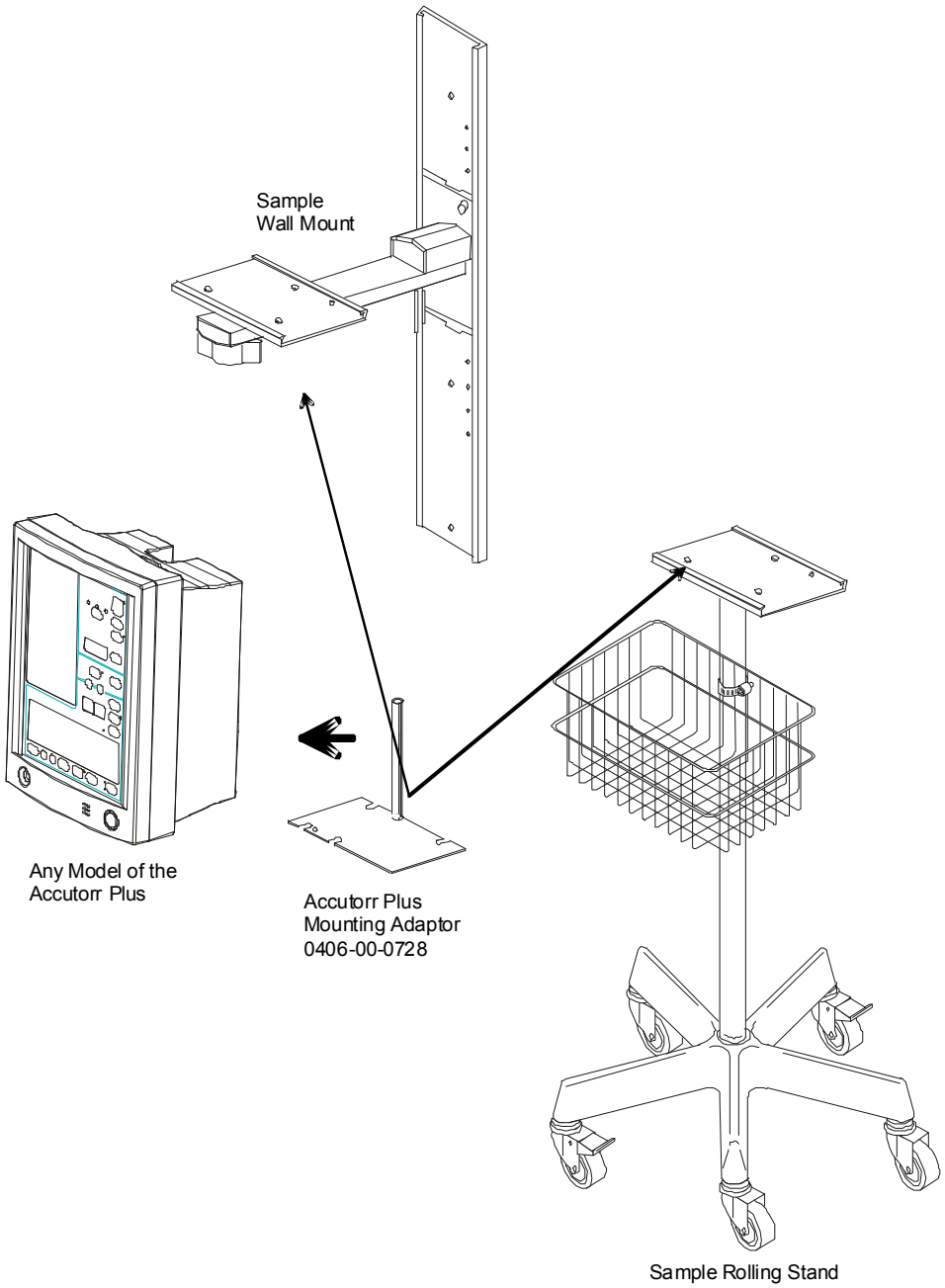


Isometric Drawing
Mobile Stand - Type 2
(Black Base)

6.8.5 Mobile Stand Type 2 (Black Base) Assembly Parts List

Figure No.	Description	Datascope Part Number
1	Basket	0436-00-0117-03
2	Pole	0436-00-0118
3	Polyurethane Sheel	0401-00-0034
4	Base Casting	0436-00-0117-02
Not Shown	Replacement Hardware Kit	0040-00-0305

6.8.6 Mounting Options



This page intentionally left blank.

Predictive Thermometer Bd Assy			0670-00-0582-XX
Item No	**Part Number**	**Description**	**Reference**
1	0014-00-0195-01	POWER SUPPLY DC/DC 3000 VDC ISOLATION 1W SIP SINGLE OUTPUT	T1
2	0060-00-0383-01	Module Specification, PTM, Accutorr Plus	
3	0060-00-0383-02	Design Documentation, PTM, Accutorr Plus	
4	0060-00-0383-03	Worst Case Analysis, PTM, Accutorr Plus	
5			
6	0060-00-0383-05	Design Validation, PTM, Accutorr Plus	
7			
8	0136-24-1010	CONNECTOR PC HEADER STRAIGHT DUAL ROW .100 PITCH	J4
9	0136-57-0044	Connector, PLCC	Socket, XU4
10	0136-92-0002	CONNECTOR PC HEADER STRAIGHT LOCKING AND POLARIZED	J2,J3
11	0151-00-0190	TRANSISTOR SMD N CHANNEL TMOS FET 2N7002	Q1
12	0151-00-0206	TRANSISTOR NTR0202 SMD P-CHANNEL MOSFET	Q2-Q4
13	0153-00-0177	DIODE 1N5817 SCHOTTKY RECTIFIER	CR1
14	0155-00-0576	IC OPTOISOLATOR CNY173	U8
15	0155-00-0849-02	IC ADC0834B 8 BIT SERIAL 4 CHANNEL ANALOG TO DIGITAL CONVERTER	U2
16	0155-00-0850-02	IC ICL7612 CMOS OPAMP	U1
17	0155-00-0853-02	IC MC34064 UNDERVOLTAGE SENSOR CIRCUIT	U6
18	0155-00-0854-02	IC LM385-2.5, 2.5V MICROPOWER REFERENCE	U10
19	0155-00-1038-02	IC S812XXSG HIGH PRECISION VOLTAGE REGULATOR, 5.0V	U5
20	0155-90-0299	IC 8 BIT MICROCONTROLLER UNIT MC68HC705C8	U4
21	0155-90-0336	IC 8 BIT MICROCONTROLLER UNIT MC68HC705C8	U3
22	0158-29-0002	CRYSTAL CMOS/TTL, 2.0000MHZ	Y1
23	0261-00-0188	SWITCH SPDT PC MOUNT	SW1
24	0261-27-0004	SWITCH SPST SIDE ACTIVATE DIP	SW2
25	0286-00-2102	CAPACITOR SMD 0805 CERAMIC 100V 5%, 1000PF	C4
26	0287-00-0103	CAPACITOR SMD 0805 CERAMIC X7R 20%, 0.01UF	C22
27	0287-00-1102	CAPACITOR SMD 0805 CERAMIC X7R 10%, 0.001UF	C1-C3,C6-C8
28	0287-00-1103	CAPACITOR SMD 0805 CERAMIC X7R 10%, 0.01UF	C5,C11,C16
29	0287-00-1104	CAPACITOR SMD 0805 CERAMIC X7R 10%, 0.1UF	C9,C10,C12-C14,C18,C19,C21,C24,C25,C28
30	0287-00-2223	CAPACITOR SMD 0805 CERAMIC X7R 5%, 0.022UF	C26

Predictive Thermometer Bd Assy			0670-00-0582-XX
Item No	**Part Number**	**Description**	**Reference**
32	0289-00-3106	CAPACITOR SMD TANTALUM 20%, 10UF	C27
33	0309-00-5901	RESISTOR METAL FILM 1/8 W 1%, 5.90K	R5
34	0309-00-8451	RESISTOR METAL FILM 1/8 W 1%, 8.45K	R7,R8
35	0311-05-2501	RESISTOR VARIABLE 1/2W 20 TURN HORI-ZONTAL, 500	R1,R2
36	0320-00-5301	RESISTOR METAL FILM 0.1% 1/8W, 5.3K	R3
37	0320-00-7501	RESISTOR METAL FILM 0.1% 1/8W, 7.5K	R4
38	0324-00-0100	RESISTOR SMD THICK FILM 1/4W 5%, 10	R28
39	0324-00-0101	RESISTOR SMD THICK FILM 1/4W 5%, 100	R30,R31
40	0324-00-0102	RESISTOR SMD THICK FILM 1/4W 5%, 1.0K	R29
41	0324-00-0104	RESISTOR SMD THICK FILM 1/4W 5%, 100K	R14-R21,R27
42	0326-01-1002	RESISTOR SMD THICK FILM 1/10W 1%, 10K	R13,R25
43	0326-01-1003	RESISTOR SMD THICK FILM 1/10W 1%, 100K	R12,R22,R23,R26
44	0326-01-2001	RESISTOR SMD THICK FILM 1/10W 1%, 2K	R24
45	0326-01-2372	RESISTOR SMD THICK FILM 1/10W 1%, 23.7K	R6
46	0326-01-3921	RESISTOR SMD THICK FILM 1/10W 1%, 3.92K	R11
47	0326-01-4752	RESISTOR SMD THICK FILM 1/10W 1%, 47.5K	R9,R10
48	0388-00-0582 REV F	PCB, PTM, Accutorr Plus	
49	0432-00-0008	Mounting Electrical, .600 pitch	Single In-Line, XSW1

Recorder Board Assembly		0670-00-0583	
Item No.	**Part Number**	**Description**	**Reference**
1	0108-00-0058	Bead, Leaded Ferrite	L1
2	0108-00-0078	INDUCTOR FIXED, 150 μH, power	L2
3	0136-00-0201	CONNECTOR PC, Test point	TP1
4	0136-00-0226	CONNECTOR PC, Receptacle, 9 pin flex cable	J3
5	0136-57-0044	SOCKET, PLCC, 44 pin	XU1
6	0136-92-0005	CONNECTOR PC, Header, straight locking and polarized, 5 pin	J2
7	0151-00-0013	TRANSISTOR, PNP, 2N3906	Q3
8	0151-00-0035	TRANSISTOR, NPN, 2N3904	Q1, Q2, Q4, Q5
9	0151-00-0133	TRANSISTOR, 2N6715, NPN, medium power	Q6, Q7
10	0153-00-0014	DIODE, PN Switching 1N4148/1N914	D1, D2
11	0153-00-0086	DIODE, PN, Rectifier, 1N5806	D3
12	0155-00-0081	IC, Hex Inverter, CMOS, 4069	U3
13	0155-00-0772-02	Quad 2 input NAND w/Schmitt trigger input, 74HC132	U4
14	0155-00-0868-01	IC, LB1257, 8 channel driver	U2
15			
16			
17	0155-90-0292-02	IC, Programmed, Printer Control (LB1257)	U1
18	0161-00-0015	RECORDER, Thermal Printer Mechanism	
19	0211-13-0206-00	SCREW, M2x0.4, 6mm long, pan head, ss	
20	0283-04-0104	CAPACITOR, Ceramic, 0.1uF, 100V, 10%	C1, C2, C7, C8, C9, C10, C11, C12, C13, C14, C15
21	0283-05-0102	CAPACITOR, Ceramic, X7R, 1000pF, 200V, 10%	C17
22	0283-10-1821	CAPACITOR, Ceramic,Ultra-Stable, 820pF, 100V, 5%	C16
23	0290-00-0122	CAPACITOR ELECTROLYTIC, Aluminum, 3300 μF, 10 V radial	C4, C5, C6
24	0290-07-2223	CAPACITOR, Electrolytic, Aluminum, 22uF, 16V, 20%	C3
25	0307-06-2102	RESISTOR NETWORK, 10 pin SIP, 1k	RN1
26	0311-01-1503	RESISTOR, Variable 1/2W, 50k, horizontal mount	R1
27	0315-00-0101	RESISTOR, FIXED, Carbon film, 1/4 W, 100, 5%	R8, R9, R22, R23, R24, R25
28	0315-00-0102	RESISTOR, FIXED, Carbon film, 1/4 W, 1k, 5%	R12, R14, R16
29	0315-00-0103	RESISTOR, FIXED, Carbon film, 1/4 W, 10k, 5%	R7, R13, R15, R18
30	0315-00-0104	RESISTOR, FIXED, Carbon film, 1/4 W, 100k, 5%	R6, R10, R11
31	0315-00-0123	RESISTOR, FIXED, Carbon film, 1/4 W, 12k, 5%	R3
32	0315-00-0164	RESISTOR, FIXED, Carbon film, 1/4 W, 160k, 5%	R2

Recorder Board Assembly			0670-00-0583
Item No.	**Part Number**	**Description**	**Reference**
33	0315-00-0202	RESISTOR, FIXED, Carbon film, 1/4 W, 2k, 5%	R17 R19
34	0315-00-0222	RESISTOR, FIXED, Carbon film, 1/4 W, 2.2k, 5%	R5
35	0315-00-0223	RESISTOR, FIXED, Carbon film, 1/4 W, 22k, 5%	R4
36	0315-00-0271	RESISTOR, FIXED, Carbon film, 1/4 W, 270, 5%	R20, R21
37	0388-00-0583	PCB, Recorder	
38		THREADED INSERT, M2x0.4	PEM P/N KFS2-M204

NIBP Circuit Board Assembly 0670-00-0584-02			
Item No.	**Part Number**	**Description**	**Reference**
1	0008-10-0204	Tubing, 1/16"	N/A
2	0008-10-0408	Tubing, 1/8"	N/A
3			
4	0103-00-0200	FTG, 1/8 to 1/16	N/A
5	0103-00-0331	Transition Barb, Rt Angle	N/A
6	0103-00-0420	PNEUMATIC MANIFOLD	N/A
7			
8	0104-00-0005	PNEUMATIC COMPONENT, VALVE, 12 VDC, 3- WAY, V1	
9	0104-00-0006	MAGNETIC COMPONENT, LINEAR VALVE, 12 VDC, N.C., V2	
10			
11	0108-00-0065	INDUCTOR, Dual winding	L1
12	0108-00-0078	INDUCTOR FIXED, 150 μH, power	L2
13			
14	0136-00-0201	Test Pin	TP1
15	0136-82-0014	CONNECTOR PC, Header, straight locking and polarized, 14 Pin	J2
16	0136-87-0034	CONNECTOR PC, Shrouded straight header w/ejector, 34 Pin	J4
17	0136-92-0003	CONNECTOR PC, Header, straight locking and polarized, 3 Pin	J3, J5
18	0136-92-0004	CONNECTOR PC, Header, straight locking and polarized, 4 Pin	J1, J6
19			
20	0151-00-0115	TRANSISTOR, 2N7000, MOSFET	Q3, Q4, Q6, Q7
21	0151-00-0195	TRANSISTOR, IRLD014, N-channel power MOSFET	Q1, Q5
22	0151-01-0010	TRANSISTOR, IRFD110, N-channel MOSFET	Q2
23	0153-00-0001	DIODE, 1N4003	D1, D8
24	0153-00-0014	DIODE, 1N4148	D10
25	0153-00-0085	DIODE, 1N6263	D2, D3, D4, D5, D6, D7
26	0153-00-0193	DIODE, Zener, 1N4749A	D9
27			
28	0155-00-0053	IC, LM324A, Quad OpAmp	U4
29	0155-00-0107	IC, LM311, Comparator	U8
30	0155-00-0404	IC, DG201A, Analog Switch	U5, U7
31	0155-00-0443	IC, LT1014, Quad OpAmp	U1, U3
32	0155-00-0805-02	IC, Dual picoamp input current OpAmp, AD706	U2
33	0155-00-0845-02	IC, TLC2543, 12 bit A/D converter	U6
34	0155-00-0858	IC, LT1004-2.5, 2.5 V micropower voltage reference	U12
35	0283-04-0334	CAPACITOR, 0.33μF 10%, 50V Ceramic	C53
36	0283-04-0104	CAPACITOR, 0.1μF 10%, 100V Ceramic	C4, C6, C8, C10, C11, C13, C14, C17, C18, C20, C21, C22, C25, C29, C31, C32, C33, C34, C51, C52
37	0283-04-0224	CAPACITOR, 0.22μF 10%, 50V Ceramic	C12

NIBP Circuit Board Assembly 0670-00-0584-02			
Item No.	**Part Number**	**Description**	**Reference**
38	0283-04-0474	CAPACITOR, 0.47μF 10%, 50V Ceramic	C7, C19, C23, C24, C48, C50
39	0283-05-0101	CAPACITOR, 100pF 10%, 200V Ceramic	C9
40	0283-05-0103	CAPACITOR, 0.01μF 10%, 100V Ceramic	C16, C26
41	0283-05-0220	CAPACITOR, 22pF 10%, 200V Ceramic	C30
42	0283-05-0332	CAPACITOR, 0.0033μF 10%, 100V Ceramic	C15
43	0285-00-0055	CAPACITOR, 0.47μF 5%, 63V Poly.	C1, C2, C3, C5, C35
44	0285-15-1473	CAPACITOR, 0.047μF 5%, 63V Poly.	C36
45	0290-02-3105	CAPACITOR, 1μF 10%, 35V, Dipped Tantalum	C28
46	0290-11-0001	CAPACITOR, 3300μF 20%, 16V, Electrolytic	C27
47			
48	0307-00-0029	RESISTOR NETWORK, 14 PIN DIP, 10K	RN1, RN2
49	0307-01-0102	RESISTOR NETWORK, 10 PIN SIP, 1K	RN3
50	0309-00-1001	RESISTOR, Metal film, 1/8 W, 1% 1K	R3, R7, R12, R15, R20
51	0309-00-1002	RESISTOR, Metal film, 1/8 W, 1% 10K	R5, R14, R49
52	0309-00-1003	RESISTOR, Metal film, 1/8 W, 1% 100K	R43
53	0309-00-1103	RESISTOR, Metal film, 1/8 W, 1% 110K	R23
54	0309-00-1213	RESISTOR, Metal film, 1/8 W, 1% 121K	R9, R46, R50
55	0309-00-1214	RESISTOR, Metal film, 1/8 W, 1% 1.21M	R17, R39
56	0309-00-1500	RESISTOR, Metal film, 1/8 W, 1% 150 Ohm	R22
57	0309-00-1502	RESISTOR, Metal film, 1/8 W, 1% 15K	R56
58	0309-00-1691	RESISTOR, Metal film, 1/8 W, 1% 1.69K	R27
59	0309-00-1823	RESISTOR, Metal film, 1/8 W, 1% 182K	R48, R52
60	0309-00-2001	RESISTOR, Metal film, 1/8 W, 1% 2K	R47, R54
61	0309-00-2212	RESISTOR, Metal film, 1/8 W, 1% 22.1K	R13, R37, R45
62	0309-00-2431	RESISTOR, Metal film, 1/8 W, 1% 2.43K	R11
63	0309-00-3012	RESISTOR, Metal film, 1/8 W, 1% 30.1K	R30
64	0309-00-3013	RESISTOR, Metal film, 1/8 W, 1% 301K	R42
65	0309-00-3321	RESISTOR, Metal film, 1/8 W, 1% 3.32K	R33

NIBP Circuit Board Assembly 0670-00-0584-02			
Item No.	**Part Number**	**Description**	**Reference**
66	0309-00-3572	RESISTOR, Metal film, 1/8 W, 1% 35.7K	R19
67	0309-00-3653	RESISTOR, Metal film, 1/8 W, 1% 365K	R55
68	0309-00-3654	RESISTOR, Metal film, 1/8 W, 1% 3.65M	R51
69	0309-00-3831	RESISTOR, Metal film, 1/8 W, 1% 3.83K	R26
70	0309-00-4751	RESISTOR, Metal film, 1/8 W, 1% 4.75K	R8
71	0309-00-5112	RESISTOR, Metal film, 1/8 W, 1% 51.1K	R16, R24
72	0309-00-5903	RESISTOR, Metal film, 1/8 W, 1% 590K	R10, R18
73	0309-00-6042	RESISTOR, Metal film, 1/8 W, 1% 60.4K	R57
74	0309-00-7500	RESISTOR, Metal film, 1/8 W, 1% 750 Ohm	R25, R58
75	0309-00-8660	RESISTOR, Metal film, 1/8 W, 1% 866 Ohm	R29
76	0310-00-0100	RESISTOR, Metal film, 1/4 W, 1% 10 Ohm	R1
77	0311-01-1501	RESISTOR, Variable , 500 Ohm	R1
78	0311-01-2502	RESISTOR, Variable, 5K	R40
79	0315-00-0102	RESISTOR, Carbon film, 1/4 W, 5%, 1K	R28
80	0315-00-0103	RESISTOR, Carbon film, 1/4 W, 5%, 10K	R21, R34, R35
81	0315-00-0104	RESISTOR, Carbon film, 1/4 W, 5%, 100K	R2, R38, R41, R44, R53
82	0315-00-0202	RESISTOR, Carbon film, 1/4 W, 5%, 2K	R36
83	0315-00-0221	RESISTOR, Carbon film, 1/4 W, 5%, 220 Ohm	R6, R31, R32
84	0212-10-0608	Screw, Nylon, Std	
85	0344-00-0223	Fastener, Snap-in	N/A
86	0220-22-0632	Nut, Hex, Nylon, Std	
87	0378-02-0004	Air Filter, 25 μm 1/8 barb	N/A
88			
89	0388-00-0584	PCB, NIBP	N/A
90			
91	0406-00-0762	Bracket, Sensors Mounting	N/A
92	0136-00-0295-06	CONNECTOR, Right Angle Socket, 6 Pin	
93	0682-00-0072	TRANSDUCER, Blood pressure sensor	PT1
94	0682-00-0086	TRANSDUCER, 7 PSIG with signal conditioning	PT2

SpO_2 Board Assembly			0670-00-0593-03
Item No.	**Part Number**	**Description**	**Reference**
1	0108-00-0019	Penta-filar wound	U17
2	0108-00-0020	Tri-filar wound	U16
3	0108-00-0058	Ferrite Bead	L1,L2,L3,L4
5	0136-00-0201	Test Point	TP1-TP5, TP8-TP11
6	0136-85-0010	CONNECTOR PC, Header, shrouded right angle w/ejector	J1,J3
7	0151-00-0182	XSTR 5308 SMD	Q1,Q2, Q3
8	0151-00-0184	XSTR 2222A SMD	Q4
9	0153-00-0168	DIODE, SMD, 5239B	CR2
11	0153-00-0175	DIODE 914/4148 SMD	CR1,5,6,9,12,14,15,16,17
12	0153-00-0176	DIODE 6263 SMD	CR7
13	0155-00-0591-03	IC uPROCESSOR 63X09E	U34
14	0155-00-0629	IC VOLTAGE REF 1004	U25
15	0155-00-0631	IC PRCN OP-AMP OP-27	U4,U21
16	0155-00-0632	IC 12 BIT MULTI. DAC AD7541A	U29
17	0155-00-0633	IC BI-FET SMP-HLD LF398	U13
18	0155-00-0635-01	IC MICRO MONITOR	U35
19	0155-00-0645	IC OPAMP TL032	U8,U9,U22
20	0155-00-0714	IC HEX INVERTER 74HCT04	U30
21	0155-00-0716	IC TL082CD	U1,U2,U11
22	0155-00-0717	IC PRECISION OP-AMP	U6,U7
23	0155-00-0718	IC LM 337LM	U28
24	0155-00-0719	IC LM317LM	U27
25	0155-00-0720-01	IC DG201 QUAD SPST ANALOG SW	U3,U5,U10,U12
26	0155-00-0721-03	IC 32KX8 STATIC RAM	U18
27	0155-00-0753	IC COMPARATOR LM 311	U36
28	0155-00-0822-01	IC TRI-STATE OCTAL 74HCT534	U33,U39,U40
29	0155-00-0901-03	IC DUART, SCC2692AC1A44	U14
30	0155-90-0235	IC PROGRAMMED PLD EP910I	U24 Blank chip is 0155-00-0494-12 (EP910ILC-15)
31	0155-90-0297	IC PROGRAMMED FLASH ROM (To be socketed.)	U26 Blank chip is 0155-00-0634-01 (AM29F010-90JC)
32	0155-90-0298	IC PROGRAMMED PLD EPM7032	U23 Blank chip is 0155-00-0673-11 (EPM7032LC44-15)
33	0158-07-0012	CRYSTAL, CLOCK OSCILLATOR	U31
34	0158-08-0005	Xtal, SMD, 3.6864 MHz.	Y1
35	0283-00-0056	CAP .1UF BYPASS	C6-24,C30-34,C36-38,C41
36	0283-04-0474	CAP .47 UF 50V 10% CER	C1-5
37	0285-08-8201	CAP .0082uF POLYPROPYLENE	C68
38	0285-15-0104	CAP POLYCARB. .1UF 63V 2.5%	C58-60,C65
38	0285-15-2104	CAP POLYCARB. .1UF 50V 1%	C58-60,C65)Alternate)
39	0285-15-0223	CAP POLYCARB. .022 UF 100V 2.5%	C61-63,C66
39	0285-15-2223	CAP POLYCARB. .022 UF 75V 1%	C61-63,C66 (Alternate)
40	0286-00-2101	CAP 100PF 100V 5% CER	C49
41	0286-00-2102	CAP 1000PF 50V NPO	C40,C42
42	0286-00-2220	CAP 22PF 100V 5% CER	C29,C35,C48,C51,C53,C54
43	0286-00-2221	CAP 220PF 100V 5% CER	C56
44	0286-00-2470	CAP 47 PF 100V 5% CER	C55
45	0286-00-2471	CAP 470PF 100V 5% CER	C57

SpO_2 Board Assembly			0670-00-0593-03
Item No.	**Part Number**	**Description**	**Reference**
46	0287-00-1103	CAP .01 UF 50V 10% CER	C28,C50
47	0287-01-1104	CAP .1UF 25V 10% CER	C25-27,C52
48	0289-01-2106	CAP 10 UF 35V 20% ALUM	C64,C67,C69,C70,C71,C72
49	0289-01-2226	CAP 22 UF 35V 20% ALUM	C45,C47,C73,C74,C75
50	0307-11-0472	Resistor Network (x4), 4.7K, 0.063W	RN1,RN2,RN3,RN4
51	0320-00-1004	RES 1 M .1% .1W	R22
52	0320-00-2913	RES 291K .1% .1W	R21
53	0320-00-5302	RES 53.OK .1% .1W	R94
54	0324-01-10R0	RES 10 ohm 1% 1/4W	R3,R10,R30,R46
55	0324-01-22R1	RES 22.1 ohm 1% 1/4W	R2
56	0324-01-27R4	RES 27.4 ohm 1% 1/4W	R1
57	0326-00-0106	RES 10M 5% .1W	R34
58	0326-01-1001	RES 1K 1% .1W	R7,R11,R12,R15,R28,R33,R44,R55,R62,R67,R69,R72,R77,R90, R104
59	0326-01-1002	RES 10K 1% .1W	R6,R17,R23,R24,R38,R40,R61,R70,R71,R75,R82,R102,R111,R112
60	0326-01-1003	RES 100K 1% .1W	R9,R14,R16,R27,R36,R51,R74
61	0326-01-1004	RES 1M 1% .1W	R45,R49,R85,R91
62	0326-01-1243	RES 124K 1% .1W	R42,R59,R65,R87
63	0326-01-1333	RES 133K 1% .1W	R4
64	0326-01-1472	RES 14.7K 1% .1W	R47
65	0326-01-1502	RES 15K 1% .1W	R43
66	0326-01-1503	RES 150K 1% .1W	R39,R41,R52,R58,R60,R66,R73,R83,R84
67	0326-01-1621	RES 1.62K 1% .1W	R68,R92
68	0326-01-1652	RES 16.5K 1% .1W	R37
69	0326-01-2003	RES 200K 1% .1W	R8
70	0326-01-2320	RES 232 ohm 1% .1W	R76,R89
71	0326-01-3013	RES 301K 1% .1W	R80
72	0326-01-3241	RES 3.24K 1% .1W	R25
73	0326-01-3742	RES 37.4K 1% .1W	R88
74	0326-01-3922	RES 39.2K 1% .1W	R29,R57
75	0326-01-3923	RES 392K 1% .1W	R18,R31
76	0326-01-4750	RES 475 1% .1W	R108
77	0326-01-4751	RES 4.75K 1% .1W	R13
78	0326-01-4752	RES 47.5K 1% .1W	R53,R63
79	0326-01-4753	RES 475K 1% .1W	R26
80	0326-01-5111	RES 5.11K 1% .1W	R32,R48
81	0326-01-6653	RES 665K 1% .1W	R5
82	0326-02-1002	RES 10K .1% .1W	R19,R20,R35,R50,R54
83	0388-00-0593	PCB, SpO2	
84	0212-12-0403	Screw, Pan Head	
85	0406-00-0693	Bracket	Not used in -03 boards
86	0349-00-0276	Insulator, SpO_2	Not used in -03 boards
87	0153-00-0197	Diode Suppressor	D6,7,8,9
88	0361-09-0402	PEM SS Standoff (KFSE-440-4)	
89	0136-57-0085	PLCC Socket	XU34
90	0136-22-0040-01	Test Point	TP6,TP7

LCD Backlite Power Supply Board 0670-00-0649			
Item No.	**Part Number**	**Description**	**Reference**
1	0014-00-0180	Power Supply, DC to AC inverter	T1 - ERG - JLA 12-202P
2	0136-91-0003	CONNECTOR PC, Header,right angle	J2
3	0136-91-0004	COINNECTOR PC, Header, right angle	J1
4	0151-00-0195	Transistor, IRLD014 MOS FET	Q1
5	0153-00-0001	Diode, IN4003	D1
6	0283-04-0104	CAP, 0.1uF 10%, 100V Ceramic	C1,C3
7	0290-01-1221	CAP, 220uF, 5%, -10%, 25V Alum	C2
8	0315-00-0104	RES., 100K 5%, 1/4W	R1
9	0385-00-0649	PCB, LCD Power	
10			

CPU/LED Board			0670-00-0650-03/04
Item No.	**Part Number**	**Description**	**Reference**
1	0014-00-0181	Power Supply DC/DC Converter 1W 15V Dual Output	T1
2	0108-00-0058	Inductor Fixed Ferrite Bead	L1-L3
3	0012-00-1237	Cable Assembly, Module, 20 pin IDC PC mount to 20 pin card edge receptacle	J5
4	0134-17-0030	Connector PC Receptacle Dual Row .100 Pitch	J2
5	0136-85-0010	Connector PC Header Shrouded Right Angle w/Ejector	J7
6	0136-85-0020	Connector PC Header Shrouded Right Angle w/Ejector	J3
7	0136-85-0026	Connector PC Header Shrouded Right Angle w/Ejector	J8
8	0136-85-0034	Connector PC Header Shrouded Right Angle w/Ejector	J1
9	0136-91-0003	Connector PC Header Right Angle Locking and Polarized	J6
10	0150-00-0058	Readout 7 Segment LED .8	DS1-DS6
11	0150-00-0059	Readout 4 Digit LED .28	DS13-DS15
12	0150-00-0060-01	Readout, DS10-DS12	GREEN, SEVEN SEGMENT LED 0.56
13	0150-00-0060-03	Readout, DS7-DS9	RED, SEVEN SEGMENT LED 0.56
14	0151-00-0013	Transistor 2N3906 PNP General Purpose	Q8,Q9
15	0151-00-0035	Transistor 2N3904 NPN General Purpose	Q7
16	0151-00-0190	Transistor SMD N Channel TMOS FET 2N7002	Q1-Q3,Q5
17	0153-00-0175	Diode SMD General Purpose Switching D914	D3-D5
18	0153-00-0177	Diode 1N5817 Schottky Rectifier	D1,D2
19	0155-00-0518	IC Multiprotocol Processor MC68302	U1
20	0155-00-0645	IC Dual JFET OPAMP TL032C	U23
21	0155-00-0692	IC 74HCT08 Quad 2 Input and Gate	U31
22	0155-00-0696	IC 74HCT74 Flip-Flop Dual D-Type Positive - Edge Triggered	U47,U48
23	0155-00-0711-01	IC Octal Buffer/Line Driver 74HCT244	U2,U6,U37
24	0155-00-0731-01	IC Quad 2 Input NOR Gate 74HCT02	U20,U13,U16
26	0155-00-0741	IC TLC555C Timer Low Power	U33
27	0155-00-0772-01	IC Quad 2 Input NAND w/Schmitt Trigger Input 74HC132	U14,U15
28	0155-00-0778	IC Audio Power Amplifier LM386	U25
29	0155-00-0779	IC Low Power Dual OPAMP LM358	U24
30	0155-00-0782-01	IC 1 OF 8 Decoder / Multiplexer 74HCT138	U11
31	0155-00-0813-01	IC Octal D Flipflop w/Reset 74HCT273	U7
32	0155-00-0816-01	IC 74HCT139 Dual 2-4 Line Decoder/Demultiplexer	U12,U29
33	0155-00-0851	IC 7218A 8 Digit LED Display Driver	U8-U10

CPU/LED Board			0670-00-0650-03/04
Item No.	Part Number	Description	Reference
33	0155-00-0851	IC 7218A 8 Digit LED Display Driver	U8-U10
34	0155-00-0860-04	IC DS1239 Micromanager	U19
35	0155-00-0864-02	IC MAX202 Dual RS232 Transceiver	U26
36	0155-00-0872-01	IC 81240 3 Terminal 4V Regulator Low Power	U17
37	0155-00-0875-02	IC AD7528 DUAL 8 BIT MULTIPLYING DAC	U22
38	0155-00-0876-01	IC 74ACT175 QUAD D FLIP-FLOP	U21
39	0155-00-0916-02	IC 74HCT374 OCTAL D TYPE FLIP FLOP W/TRISTATE OUTPUTS	U41,U43,U46
40	0155-00-0947-02	IC 74ACT623 OCTAL BUS TRANSCEIVER TRI-STATE NON-INVERTING	U30,U34
41	0155-00-0948-02	IC SP720 ESD PROTECTION ARRAY 14 CIRCUIT	U35
42	0155-00-0950-02	IC SP723 ESD PROTECTION ARRAY 6 CIRCUIT ENHANCED	U36
43	0155-00-0951-02	IC 628512 STATIC RAM 512K X 8 LOW POWER	U4,U5
44	0155-00-1681-02	IC 4MEG LP SRAM 512K X 8	Alternate for U4 and U5
45	0155-00-0952-02	IC 74HCT123 DUAL RETRIGGERABLE MONOSTABLE MULTIVIBRATOR	U32,U38,U40,U39
46	0155-00-0955-02	IC 74HCT125 QUAD BUFFER/LINE DRIVER WITH TRI-STATE OUTPUTS	U18, U100
48	0155-00-0962-03	IC DS1642 NONVOLATILE TIMEKEEPING RAM	U28
49	0136-00-0154	Socket, SMD, 32 pin PLCC	XU3, XU27
50	0158-05-0009	CRYSTAL CLOCK OSCILLATOR W/TRISTATE, 16.00MHZ	Y2
51	0283-00-0056	CAPACITOR SMD 0805 CERAMIC 20%, 0.1UF	C3,C4,C12-C18,C20-C23,C25-C41,C43-C56,C64, C67,C68,C71-C76,C83-C85,C88,C90,C92,C93,C96-C98,C100,C106,C107,C110-C112
52	0286-00-2102	CAPACITOR SMD 0805 CERAMIC 100V 5%, 1000PF	C103,C105,C108,C109
53	0286-00-2151	CAPACITOR SMD 0805 CERAMIC 100V 5%, 150PF	C2,C99,C104
54	0287-00-0222	CAPACITOR SMD 0805 CERAMIC X7R 20%, 0.0022UF	C1
55	0287-00-1102	CAPACITOR SMD 0805 CERAMIC X7R 10%, 0.001UF	C59
56	0287-00-1103	CAPACITOR SMD 0805 CERAMIC X7R 10%, 0.01UF	C57,C58,C60,C69,C70,C78,C79,C82,C91
57	0287-00-1223	CAPACITOR SMD 0805 CERAMIC X7R 10%, 0.022UF	C86,C87,C89
58	0287-01-2224	CAPACITOR SMD 1206 CERAMIC X7R 5%, 0.22UF	C101,C102
59	0289-00-3476	CAPACITOR SMD TANTALUM 20%, 4.7UF	C77
60	0289-00-3105	CAPACITOR SMD TANTALUM 20%, 1UF	C94

CPU/LED Board			0670-00-0650-03/04
Item No.	**Part Number**	**Description**	**Reference**
61	0289-00-3476	CAPACITOR SMD TANTALUM 20%, 47UF	C7-C9
62	0289-01-2106	CAPACITOR SMD ELECTROLYTIC 20%, 10UF	C63
63	0289-01-2226	CAPACITOR SMD ELECTROLYTIC 20%, 22UF	C61,C62
64	0289-01-4226	CAPACITOR SMD ELECTROLYTIC 20%, 22UF	C11,C65,C80
65	0289-01-4476	CAPACITOR SMD ELECTROLYTIC 20%, 47UF	C5,C6,C10,C81
66	0289-01-5107	CAPACITOR SMD ELECTROLYTIC 20%, 100UF	C66
67	0307-20-2202	RESISTOR SPECIAL NETWORK 15 ELEMENT BUSSED 1%, 22.0K	RN1-RN4
68	0307-21-1000	RESISTOR NETWORK 8 ELEMENT ISOLATED , 100 ohm	RN6,RN8,RN10
69	0324-00-0100	RESISTOR SMD THICK FILM 1/4W 5%, 10	R28-R30
70	0324-00-0101	RESISTOR SMD THICK FILM 1/4W 5%, 100	R14,R23,R24
71	0324-00-0103	RESISTOR SMD THICK FILM 1/4W 5%, 10K	R1
72	0324-00-0104	RESISTOR SMD THICK FILM 1/4W 5%, 100K	R44
73	0324-00-0122	RESISTOR SMD THICK FILM 1/4W 5%, 1.2K	R10
74	0324-00-0330	RESISTOR SMD THICK FILM 1/4W 5%, 33	R32
75	0326-00-0101	RESISTOR SMD THICK FILM 1/10W 5%, 100	R50
76	0326-01-1000	RESISTOR SMD THICK FILM 1/10W 1%, 100	R20,R35,R43,R46,R47,R49,R52,R53,R55-R71,R73-R75,R77,R79-R89
77	0326-01-1001	RESISTOR SMD THICK FILM 1/10W 1%, 1K	R4-R6,R17,R25,R37-R40,R54
78	0326-01-1002	RESISTOR SMD THICK FILM 1/10W 1%, 10K	R2,R7,R9,R13,R15,R18,R19,R21,R22,R27,R33,R34 ,R42,R78
79	0326-01-1003	RESISTOR SMD THICK FILM 1/10W 1%, 100K	R11,R48,R72
80	0326-01-1004	RESISTOR SMD THICK FILM 1/10W 1%, 1MEG	R3,R90
81	0326-01-2001	RESISTOR SMD THICK FILM 1/10W 1%, 2K	R31,R36
82	0326-01-2003	RESISTOR SMD THICK FILM 1/10W 1%, 200K	R12
83	0326-01-2211	RESISTOR SMD THICK FILM 1/10W 1%, 2.21K	
84	0326-01-2492	RESISTOR SMD THICK FILM 1/10W 1%, 24.9K	R26
85	0326-01-2741	RESISTOR SMD THICK FILM 1/10W 1%, 2.74K	R45
86	0326-01-3321	RESISTOR SMD THICK FILM 1/10W 1%, 3.32K	R16
87	0326-01-3323	RESISTOR SMD THICK FILM 1/10W 1%, 332K	R8

CPU/LED Board			0670-00-0650-03/04
Item No.	**Part Number**	**Description**	**Reference**
88	0326-01-7680	RESISTOR SMD THICK FILM 1/10W 1%, 768	R51
89	0326-01-8063	Resistor SMD Thick Film 1/10W 1%, 806K	R41
90	0326-01-9533	Resistor SMD Thick Film 1/10W 1%, 953K	R76
91	0388-00-0650	PCB, CPU MODULE	
92	0432-00-0005	MOUNTING, 0.28" LED	XDS13, XDS14, XDS15
93	0136-10-0023	MOUNTING, 0.8" LED	2 per for DS2&DS4, DS3&DS5 and DS1&DS4
95	0155-90-0413	IC, Programmed, Accutorr	U3
96	0155-90-0412	IC, Programmed, Accutorr	U27
97	0136-10-0015	MOUNTING, 0.56" LED	for DS7- DS12
98	0012-00-1236	Cable Assembly, Module, 20 pin IDC PC mount to 20 pin card edge receptacle	J4
99	0326-01-2212	Resistor SMD Thick Film 1%, 22.1K	R91

Communication Board			0670-00-0661-01
Item No.	**Part Number**	**Description**	**Reference**
1	0012-00-1090	Cable Assembly RS232 9 PIN D TO 10 PIN IDC PC Mount	J2
2	0012-00-1091	Cable Assembly 20 PIN IDC TO 20 PIN IDC PC Mount	J1
3	0108-00-0089	Inductor Dual Surface Mount, 20UH	L1
4	0136-92-0003	Connector PC Header Straight Locking and Polarized	J3
5	0151-00-0190	Transistor SMD N Channel TMOS FET 2N7002	Q2
6	0151-00-0203	Transistor MMFT3055 MOSFET POWER Switching SMD	Q1
7	0153-00-0175	Diode SMD General Purpose Switching D914	D2
8	0153-00-0186	Diode 1N5819 Schottky Rectifier, SMD MELF	D1,D3
9	0153-00-0211	Diode SM14M24 Transient Voltage Suppressor SMD	U3
10	0155-00-0676	IC Low Power Transceiver RS485 LTC485	U5
11	0155-00-0692	IC QUAD 2 Input NAND GATE 74HCT08	U4
12	0155-00-0958-02	IC MAX239 Multichannel RS232 Driver/Receiver	U2
13	0155-00-0960-02	IC MAX1771 DC-DC Controller High Efficiency	U1
14	0283-00-0056	Capacitor SMD 0805 Ceramic 0.1UF 20%	C1,C9,C10,C12,C15,C16 (C13-14 -02 ONLY)
15	0287-00-1103	Capacitor SMD 0805 Ceramic X7R 10%, 0.01UF	C7,C11, C18
16	0289-02-6106	Capacitor SMD Tantalum 20%, 10UF, 35 VDC	C3
17	0289-00-3106	Capacitor SMD Tantalum 20%, 10UF	C5
18	0289-00-3475	Capacitor SMD Tantalum 20%, 4.7UF	C6
19	0289-02-4336	Capacitor SMD Tantalum 20%, 33UF	C2,C4,C17
20	0289-00-5226	Capacitor SMD Tantalum 20%, 22UF	C8
21	0327-00-0R10	Resistor SMD 1/4W 5% Low Value, 0.1	R1
22	0326-00-0121	Resistor SMD Thick FILM 1/10W 5%, 120	R8
23	0326-00-0472	Resistor SMD Thick FILM 1/10W 5%, 4.7K	R10
24	0326-01-1000	Resistor SMD Thick FILM 1/10W 1%, 100	R9
25	0326-01-1002	Resisotr SMD Thick FILM 1/10W 1%, 10K	R4-R6
26	0326-01-2003	Resistor SMD Thick FILM 1/10W 1%, 200K	R3
27	0326-01-2802	Resistor SMD Thick FILM 1/10W 1%, 28K	R2
28	0388-00-0661	PCB, Communications Module	

Power Supply, Sealed Lead Acid 0014-00-0184			
Item No.	**Part Number**	**Description**	**Reference**
1		Fuse, Micro, time lag 4A/250 V	F1, F2
2		PC Assembly Dwg.	
3		Inductor, GPx80's	T1
4		Choke Noise	L1,3
5		XFMR, Current, EP7	T4, 5
6		XMFR-EMI Inductor, GPM40's	T6
7		Output Storage Choke	L2
8		XFMR DC/DC, MSP1510	T3
9		XFMR-Power, MSP1510	T2
10		SEC Heatsink, MSP1510	FN1
11		PRI FET Bracket, MSP1510	FN2
12		Sub Assy B/M	A1
13		Cap DK R Acy 250V 220PF	C5,6
14		Cap MO R Z5U 1.0 MF 20%	C23.47,53
15		Cap MO A X7R 50V 0.001 MF 10%	C51
16		Cap MO Z X7R 50V 0.1 MF 10%	C55
17		Cap MO A X7R 50V 0.0047 MF 10%	C54
18		Cap Al R 1 25V 100.00MF KME	C43
19		Cap Al R 1 63V 10.00MF KME	C30
20		Cap Al R 1 25V 47.00MF KME	C2,17,21,32
21		Cap AL R 1 35V 390.00MF LXF	C14,16,19,42,45
22		Cap AL R 1 35V 220.00MF LXF	C11,12,17,34
23		Cap AL R 1 400V 82.00MF KMH	C7
24		Cap FI R ACX 250V 0.100MF	C1
25		Tstr P 60V 0.6A 2907A	C6,12
26		Tstr P 40V 3.0A TIP32	Q3
27		Tstr FET N 600V 6.0A MTP6N60	Q1
28		Tstr FET N 60V 35.0A IRFZ44	Q11
29		Tstr FET P 60V 12.0A MTP2955E	Q5
30		Tstr FET N 100V 1.0A IRFD110	Q16
31		Tstr FET P 45V 0.18A BS250	Q2
32		Rect 1xSCH 45V 10A MBR1045	CR9,10
33		Rect 1xUFR 300V 8A BYTO8P300	CR11
34		Diode ZNR 1.0W 5% P 3.3V	CR14
35		Diode ZNR 1.0W 5% P 18.0V	CR4
36		Rect UFR 1000V 1.0A MUR1100 P	CR2
37		Rect Bridge 600V 2A Small	CR1
38		IC VR ADJ SHUNT TL431 TO-92	U4
39		IC VR - 15V 4% 0.5A 79M15 TO220	U3
40		IC VR +15V 4% 0.5A 78M15 TO220	U5
41		IC Volt Detector ICL7665CPA	U8
42		SCR 50V 8.0A S-Gate TO-220	SCR1
43		Opto-Coupler TSTR 4N35	U2
44		IC PWM Current Mode 3844	U1
45		IC PWM Current Mode 3843	U6
46		IC PWM Current Mode 3845	U9
47		Varistor 300VAC 80J	M1
48		IC Batt Charger UC3906	U7

Power Supply, Sealed Lead Acid 0014-00-0184			
Item No.	**Part Number**	**Description**	**Reference**
49		Res F CF 1/4W 5% P 27.0 Ohm	R36
50		Res F CF 1/4W 5% P 4.7 Ohm	R18
51		Res F CF 1/2W 5% P 220.0 OK Ohm	R25
52		Res F MO 1W 5% MP 470.00 Ohm	R59
53		Res F MF 1/4W 1% P 16.50K Ohm	R37
54		Res F MF 1/4W 1% P 26.70K Ohm	R57
55		Res F MF 1/4W 1% P 274.00K Ohm	R57
56		Res F MF 1/4W 1% P 226.00K Ohm	R4,21
57		Res F MF 1/4W 1% P 7.32K Ohm	R8
58		Res F MO 2W 5% P 120.00K Ohm	R2
59		Res F MO 2W 5% NP 33.00K Ohm	R16
60		Thermistor NTC 10.0 Ohm 1.7A	RT1
61		Res F MO 1W 5% NP 10.00K Ohm	R46
62		Res F MO 1W 5% NP 220.00 Ohm	R33
63		Res V CE 1/3W H-Adj 500 Ohm	R80
64		Res F MO 1W 5% P 0.47 Ohm	R1,22
65		Res F CF 1/8W 5% SP 47.0K Ohm	R38
66		Res F CF 1/8W 5% SP 330.0 Ohm	R61
67		Res F CF 1/8W 5% SP 820.0 Ohm	R79
68		Res F CF 1/8W 5% SP 56.0K Ohm	R81
69		Res F CF 1/8W 5% SP 100.0 Ohm	R19
70		Res F MF 1/8W 1% P 365.00K Ohm	R45
71		Res F MF 1/8W 1% P 1.37M Ohm	R56
72		Res F MF 1/8W 1% P 475.00 Ohm	R77
73		Res F MF 1/8W 1% P 60.40K Ohm	R49
74		Res F MF 1/8W 1% P 681.00K Ohm	R17
75		Res F MO 1/4W 5% P 22.00 Ohm	R14
76		Res F MO 1/4W 5% P 47.00 Ohm	R3,32
77		Res F MO 1/4W 5% P 33 Ohm	R44
78		Res F MO 1/4W 5% P 4.70 Ohm	R53
79		Res F MO 1/4W 5% NP 10.00 Ohm	R28
80		Res F MO 1/4W 5% P 150.00 Ohm	R58
81		Res F MO 1/4W 5% P 220.00 Ohm	R12
82		Wire Jumper Ins 22GA 0.300	W2
83		Wire Jumper Ins 22GA 0.400	W1
84		Sleeving Heatshrink Blk 3/4"	FOR:M1
85		Wire Preformed Test Point	FOR:COM, VBULK
86		Conn. Hdr. 1 Ctr Locking 14 Pos	J3
87		Conn Hdr. Amp 640445-3	J4
88		Conn., PCB, HDR., LCK., PTL/LDG, 3C	J2
89		Fusectip 5X20MW Brass	FOR:F3
90		SPRINGCLIP, MOUNTING, TO-220	FN3
91		Nut, Assem LK Wash, 4-40, STD PAT	FN4

Power Supply, Sealed Lead Acid 0014-00-0184			
Item No.	**Part Number**	**Description**	**Reference**
92		Screw, PNHD, 4-4OX, .312, PHIL	FN5
93		Screw, PNHD, 4-40 X .437, PHIL	FN6
94		Standoff, Swage, 4-40 x.125	FN7
95		Washer, Shoulder, 4-40x.090	FN8
96		Screw, FLHD 4-40x.312, 100 DEG	FN9
97		Washer, Shoulder, TO-220	FN10
98		Insulator Silpad 0.6" x 0.87"	FN12
99		Insulator Silpad 0.6" x 0.87"	FN12
100		Fuse 5X20 U/C T 4.00A 125V	F3
101		Tubing Teflon Clear 20GA	FOR:R46,59
102		PCB-BARE, D/S. MSP1510, PN1X	PCB
103		Cap MO SM X7R 50V 100NF 1206	C24,33,35,36,44,48,49,50
104		Cap MO SM Z5U 50V 330NF 1210	C15,22,46
105		Cap MO SM X7R 100V 10NF 1206	C4,13,27,28, 29,31
106		Cap MO SM X7r 200V 1000PF 1206	C3,8,25,26,37,38,52
107		Cap MO SM X7R 200V 2200PF 1206	C39
108		Cap MO SM X7R 200V 470PF 1206	C9
109		Cap MO SM X7R 200V 4700PF 1206	C41
110		Cap MO SM X7R 500V 10NF 1210	C10,20,40
111		Tstr N 40V 0.6A MBT2222A	Q7,10,14
112		Tstr P 60V 0.6A MBT2907A	Q4,13, 15
113		Diode ZNR 0.5W 5% SMD 5.6V	CR18
114		Diode ZNR 0.5W 5% SMD 13.0V	CR12, 19
115		Diode ZNR 0.5W 5% SMD 20.0V	CR8
116		Diode Signal DL4448	CR15, 20,22,23,24,26
117		Rect UFR 200V 1.0A MUR120 SMT	CR3,6,7,16,17,21
118		Res F SM 1/4W 1% 365.00K Ohm	R30,50,62
119		Res F SM 1/4W 1% 1.00K Ohm	R5,13,31,34,43,69,70,71,78
120		Res F SM 1/4W 1% 10.70K Ohm	R10,23,63,64,76
121		Res F SM 1/4W 1% 1.24K Ohm	R9,39
122		Res F SM 1/4W 1% 1.30K Ohm	R40
123		Res F SM 1/4W 1% 13.70K Ohm	R7
124		Res F SM 1/4W 1% 1.50K Ohm	R42
125		Res F SM 1/4W 1% 17.80K Ohm	R72
126		Res F SM 1/4W 1% 221.00 Ohm	R20
127		Res F SM 1/4W 1% 2.21K Ohm	R26,29
128		Res F SM 1/4W 1% 22.10K Ohm	R41
129		Res F SM 1/4W 1% 44.20K Ohm	R27
130		Res F SM 1/4W 1% 475.00 Ohm	R6,35
131		Res F SM 1/4W 1% 4.75K Ohm	R11,55,66
132		Res F SM 1/4W 1% 49.90K Ohm	R24
133		Res F SM 1/4W 1% 7.50K Ohm	R51
134		Res F SM 1/4W 5% 10.0 Ohm	R54
135		Res F SM 1/4W 5% 47.0 Ohm	R15,60
136		Res F SM 1/3W 5% 1.0K Ohm	R65,67,68
137		Fuse, Micro, Time Lag 4A/125V	F3

Power Supply, Lithium Ion			0014-00-0225
Item No.	Part Number	Description	Reference
1		PCB-BARE,SMT D/S,MSP1698,PN1X	PCB
2		INDUCTOR,GPx80'S	T1
3		CHOKE,NOISE	L1,3
4		XFMR,CURRENT,EP7	T4,5
5		XFMR-EMI INDUCTOR	T6
6		OUTPUT STORAGE CHOKE	L2
7		XFMR-DC/DC,MSP1698	T3
8		XFMR-POWER,MSP1698	T2
9		INDUCTOR,MSP1698	L4
10		PRI FET BRKT W/HDWR,MSP1510	FN1
11		L BRKT W/HDWR & S/S,MSP1698	FN1
12		Cap DK R ACY 250V 220PF	C5,6
13		Cap DK R X7R 1KV 125C 10000PF	C10
14		Cap AL R 105C 25V 100.00MF S	C43
15		Cap AL R 105C 25V 47.00MF S	C18,21
16		Cap AL R 105C 50V 47.00MF S	C2
17		Cap AL Lo-Z 105C 35V 390MF	C16,19,42,45
18		Cap AL Lo-Z 105C 35V 220MF	C11,12,34
19		Cap AL R 105C 400V 82MF 22X30	C7
20		Cap FI R ACX 275V 0.100MF	C1
21		Cap Tant SMT 10.0uF 20V 3528	C32,35,58
22		Cap Tant SMT 1.0uF 16V 3612	C23,47,48,53
23		Cap SMT 10.0nF 10% 100V 0805	C4,13,20,27,28,29,49
24		Cap SMT 0.1uF 10% 25V 0805	C24,30,33,36,44,50,55
25		Cap SMT 1.0nF 10% 100V 0805	C8,25,38,51,52
26		Cap SMT 47.0nF 10% 50V 0805	C31
27		Cap SMT 1.0nF 5% 50V 1206	C3,26,37,41
28		Cap SMT 4.7pF 10% 50V 0805	C57
29		Cap SMT 2.2nF 10% 200V 1206	C39,56
30		Cap SMT 470.0pF 10% 200V 1206	C9,40,59
31		Cap SMT 4.7nF 10% 200V 1206	C54
32		Cap SMT 0.33uF 20% 50V 1210	C15,22,46
33		Tstr P 60V 0.6A 2907A	Q6
34		Tstr FET N 600V 6.0A TO-220	Q1
35		Tstr FET P 45V 0.18A BS250	Q2
36		Tstr N 40V 0.6A MBT2222A	Q7,8,9,10,14,17,20
37		Tstr P 60V 0.6A MBT2907A	Q4,12,13,15,18,19
38		Tstr FET N 60V 20.0A D-PAK	Q11
39		Tstr FET P 30V 19.0A D-PAK	Q3
40		Tstr FET N 60V .12A SOT23	Q16
41		Tstr FET P 60V 12.0A TO-220	Q5
42		Rect UFR 1000V 1.0A MUR1100 P	CR20
43		Rect Bridge 600V 2A Small	CR1
44		Rect SCH 40V 3.0A SMD	CR5,13,17
45		Rect 2 X SCH 40V 3.0A SMD	CR9

Power Supply, Lithium Ion			0014-00-0225
Item No.	Part Number	Description	Reference
46		Diode ZNR 1.0W 5% SMD 3.9V	CR14
47		Diode ZNR SMT 5.1V 5% SOT23	CR20
48		Diode ZNR SMT 12.0V 5% SOT23	CR16,19
49		Diode ZNR 1.0W 5% SMD 18.0V	CR4
50		Diode ZNR SMT 18.0V 5% SOT23	CR8
51		Rect UFR 200V 1.0A MUR120 SMT	CR3,6,7,21
52		Rect Schtky SMT 30V 0.3A SOT23	CR12,15,22,23,24
53		Rect 1xSCH 45V 10A MBR1045	CR10
54		Rect 1xUFR 300V 8A BYT08P300	CR11
55		IC VR +15V 2% 0.5A 78M15 TO220	U5
56		IC VR -15V 1% 0.5A 79M15 TO220	U3
57		IC Volt Detector ICL7665CPA	U8
58		IC VR SHUNT TL431 2.0% SOP-8	U4
59		Opto-Coupler TSTR 4N35	U2
60		Varistor 300VAC 80J	M1
61		IC PWM 3844 SO-8	U1
62		IC PWM 3843 SO-8	U6,9
63		IC Batt Charger BQ2000 SOIC	U7
64		Res F CF 1/4W 5% P 4.7 Ohm	R18
65		Res F MF 1/4W 1% P 226.00K Ohm	R4,21
66		Res F MO 2W 5% P 0.10 Ohm	R22
67		Res F MO 2W 5% P 120.00K Ohm	R2
68		Res F MO 2W 5% NP 33.00K Ohm	R16
69		Thermistor NTC 10.0 Ohm 1.7A	RT1
70		Res F MO 1W 5% NP 470.00 Ohm	R46,59
71		Res F MO 1W 5% P 0.47 Ohm	R1
72		Res F MO 1/4W 5% P 22.00 Ohm	R14
73		Res F CF 1/4W 5% NP 47.0 Ohm	R28
74		Res SMT 1.00KOhm 1% 1206	R69,70,71,75
75		Res SMT 150.00KOhm 1% 1206	R57
76		Res SMT 200.00KOhm 1% 1206	R25,74
77		Res SMT 221.00 Ohm 1% 1206	R32,83
78		Res SMT 27.40 Ohm 1% 1206	R36,54
79		Res SMT 365.00KOhm 1% 1206	R30,50,62,87
80		Res SMT 681.00KOhm 1% 1206	R48,79
81		Res F SM 1/3W 5% 1.0K Ohm	R65,67,68
82		Res F SM 1/4W 5% 47.0 Ohm	R84
83		Res SMT 4.7 Ohm 5% 1206	R53
84		Res F SM 1/4W .25% 1.24K Ohm	R9,19,39,40,52
85		Res SMT 1.00K Ohm 1% 0805	R5,13,31,34,43,78,82,85,88
86		Res SMT 1.00K Ohm 1% 0805	R95
87		Res SMT 10.70K Ohm 1% 0805	R10,23,45,58,63,76,93
88		Res SMT 113.00K Ohm 1% 0805	R17,47
89		Res SMT 124.00 Ohm 1% 0805	R90
90		Res SMT 13.70K Ohm 1% 0805	R7

Power Supply, Lithium Ion			0014-00-0225
Item No.	Part Number	Description	Reference
91		Res SMT 1.50K Ohm 1% 0805	R42,96
92		Res SMT 16.50K Ohm 1% 0805	R37
93		Res SMT 17.80K Ohm 1% 0805	R72,86
94		Res SMT 221.00 Ohm 1% 0805	R12,20,92
95		Res SMT 2.21K Ohm 1% 0805	R26,29
96		Res SMT 22.10K Ohm 1% 0805	R15,41
97		Res SMT 3.32M Ohm 1% 0805	R56
98		Res SMT 33.20 Ohm 1% 0805	R89
99		Res SMT 475.00 Ohm 1% 0805	R6,33,35,61,77
100		Res SMT 4.75K Ohm 1% 0805	R11,55,66,94
101		Res SMT 47.50K Ohm 1% 0805	R24,38,81,91
102		Res SMT 47.50 Ohm 1% 0805	R3,60,80
103		Res SMT 54.90K Ohm 1% 0805	R27
104		Res SMT 6.19K Ohm 1% 0805	R8,51
105		Res SMT 150.00KOhm 0.1% 1206	R49
106		Wire Jumper Ins 22GA 0.300"	W1
107		Wire Jumper Ins 18GA 0.750"	FOR: F3
108		Sleeving Heatshrink BLK 3/4"	For: M1
109		Conn Hdr .1 Ctr Locking 14 Pos	J3
110		Conn Hdr Amp 640445-3	J4
111		HEADER-3 POS,.312 CENTERS	J2
112		NUT,ASSEM LK WASH.,6-32,SM PAT	FN11
113		Screw PnHd 4-40 X .312 Phil	FN3
114		Washer Flt Stl Narrow 0.25 OD	FN4
115		WASHER,SPLIT LOCK, #4	FN2
116		Screw UC FLT HD 4-40 .312	FN12
117		Insulator,Nomex,MSP1510	FN8
118		Clamp TO-220 Nylon	FN5
119		Insulator Silpad 0.6" X 0.87"	FN6
120		Screw FH 100 Deg 6-32 X 0.500"	FN7
121		Screw FH 100 Deg 6-32 X 0.625"	FN10
122		Clamp Bar GPFC110	FN9
123		SPRINGCLIP,MOUNTING,TO-220	FN3
124		STANDOFF,SWAGE,4-40 x .250	FN4
125		Insulator Silpad 0.6" X 0.87"	FN2
126		Fuse Micro Time-Lag 4.00A 250V	F1,2
127		Tubing Teflon Clear 20GA	FOR R59
128		LABEL-BARCODE,MSP1698	FN13
129		CAP AL LO-Z 105C 25V 560MF	C60,C14,C17

Nellcor Interface BD		P/N 0670-00-0675	
Item No	**Part Number**	**Description**	**Reference**
1	0014-00-0047	POWER SUPPLY, ISOLATED DC/DC CONVERTER, 5V TO 5V	T1
2	0014-00-0200	POWER SUPPLY, DC/DC CONVERTER, 1W, +/- 9V	T2
3			
4	0108-00-0095	INDUCTOR, POWER SMD, 22uH	L1
5	0136-00-0201	CONNECTOR, TEST POINT	TP1(GND), TP2(+5V), TP3(RX), TP4(RST*), TP5(TX), TP6(+5AN), TP8(+5DIG), TP9(-5AN)
6	0136-00-0287-07	CONNECTOR, RECEPTACLE, DUAL ROW	J2
7	0136-85-0010	CONNECTOR, HEADER, SHROUDED RIGHT ANGLE W/EJECTOR	J1
8	0136-91-0003	CONNECTOR, HEADER, RIGHT ANGLE LOCKING AND POLARIZED	J3
9	0136-91-0004	CONNECTOR, HEADER, RIGHT ANGLE LOCKING AND POLARIZED	J4
10			
11	0153-00-0209	DIODE, MBRS130L, SCHOTTKY POWER RECTIFIER, 30V	D1-D3
12	0155-00-0775	IC, +5V REGULATOR, 78L05A	U4
13	0155-00-0776	IC, -5V REGULATOR, 79L05A	U5
14	0155-00-0791-01	IC, QUAD, 2 INPUT NAND GATE, 74HCT00	U3
15	0155-00-1007-01	IC, HCPL2212, OPTOCOUPLER, LOGIC OUTPUT	U2
16	0155-00-1007-02	IC, HCPL2232, OPTOCOUPLER, LOGIC OUTPUT	U1
17	0155-00-1062-01	IC, MAX710, 3.3/5V STEP-UP/DOWN DC/DC CONVERTER	U6
18			
19	0287-00-1104	CAPACITOR, SMD 0805, CERAMIC X7R, 10%, 0.1UF	C1-C3,C6,C9,C11
20	0289-00-5475	CAPACITOR, SMD, TANTALUM, 20%, 4.7UF	C7
21	0289-02-3107	CAPACITOR, SMD, TANTALUM SWITCH MODE, 100UF	C4,C5,C98,C99
22	0289-02-5336	CAPACITOR, SMD, TANTALUM SWITCH MODE, 33UF	C8,C10
23	0325-01-1001	RESISTOR, THIN FILM, 1/8W, 1%, 1206, 1K	R3-R5, R7
24	0325-01-1002	RESISTOR, THIN FILM, 1/8W, 1%, 1206, 10K	R1,R2, R6
25			
26			
27	0361-00-0752	Support Post, PCB Lock Mount, Nylon	
28	0361-09-0402	Standoff, Broaching type PCB	
29	0388-00-0675	PCB, Nellcor Interface Board	
30			
31	0060-00-0979-01	Module Specification, Nellcor Interface Board	
32	0060-00-0979-02	Design Documentation, Nellcor Interface Board	
33	0060-00-0979-03	Worst Case Analysis, Nellcor Interface Board	
34	0060-00-0979-05	Design Validation, Nellcor Interface Board	
35	0060-00-0979-06	Production Test Specification, Nellcor Interface Board	

Masimo SpO2 Assy			0670-00-0716
Item No	**Part Number**	**Description**	**Reference**
1			
2	0014-00-0229	POWER SUPPLY ISOLATED DC/DC CONVERTER 5V TO 5V	T1
3	0108-00-0092	INDUCTOR FIXED, 150UH	L1
4	0108-11-0100	INDUCTOR MOLDED SURFACE MOUNT 1812, 10UH	L2,L3
5			
6	0136-00-0201	CONNECTOR PC TEST POINT	TP1-TP9
7	0136-00-0299-06	CONNECTOR SMT PASS-THRU RECEPTACLE .100" x .100"	J5
8	0136-00-0302	CONNECTOR SMT HEADER .100"x .100"	J6
9	0136-85-0014	CONNECTOR PC HEADER SHROUDED RIGHT ANGLE W/EJECTOR	J2
10	0136-85-0010	CONNECTOR PC HEADER SHROUDED RIGHT ANGLE W/EJECTOR	J1
11	0136-91-0004	CONNECTOR PC HEADER RIGHT ANGLE LOCKING AND POLARIZED	J4
12			
13			
14	0153-00-0209	DIODE MBRS130LT3 SCHOTTKY POWER RECTIFIER 30V	CR5, CR6
15	0153-00-0210	DIODE MBRS1100 SCHOTTKY POWER RECTIFIER 100V	CR3, CR4
16	0155-00-0791-01	IC QUAD 2 INPUT NAND GATE 74HCT00	U3
17	0155-00-0950-02	IC SP723 ESD PROTECTION ARRAY 6 CIRCUIT ENHANCED	U5
18	0155-00-0974-01	IC LT1373 SWITCHING REGULATOR 1.5A	U4
19	0155-00-1007-01	IC HCPL2212 OPTOCOUPLER LOGIC OUTPUT	U2
20	0155-00-1007-02	IC HCPL2232 OPTOCOUPLER LOGIC OUTPUT	U1
21			
22			
23	0286-03-2102	CAPACITOR SMD 1206 CERAMIC 100V 5%, 1000PF	C8
24	0287-00-1103	CAPACITOR SMD 0805 CERAMIC X7R 10%, 0.01UF	C23,C24,C25,C26
25	0287-00-1104	CAPACITOR SMD 0805 CERAMIC X7R 10%, 0.1UF	C1,C2,C3,C5,C7
26	0289-02-3107	CAPACITOR SMD TANTALUM SWITCH MODE, 100UF, 16V	C6,C17
27	0289-02-4476	CAPACITOR SMD TANTALUM SWITCH MODE, 47UF, 20V	C18
28			
29	0289-02-6106	CAPACITOR SMD TANTALUM SWITCH MODE, 10UF, 35V	C12,C13
30	0289-02-6226	CAPACITOR SMD TANTALUM SWITCH MODE, 22UF, 35V	C14,C15
31	0289-02-7106	CAPACITOR SMD TANTALUM SWITCH MODE, 10UF, 50V	C16
32	0325-01-1001	RESISTOR THIN FILM 1/8W 1.0% 1206, 1K	R3-R5,R8
33	0325-01-1002	RESISTOR THIN FILM 1/8W 1.0% 1206, 10K	R1,R2,R6,R9
34	0325-01-4640	RESISTOR THIN FILM 1/8W 1.0% 1206, 464	R11
35	0325-01-5111	RESISTOR THIN FILM 1/8W 1.0% 1206, 5.11K	R10

Masimo SpO2 Assy			0670-00-0716
Item No	**Part Number**	**Description**	**Reference**
36			
37			
38	0361-09-0402	STANDOFF, BROACHING TYPE PCB	
39	0388-00-0716 REV 2	PCB, MASIMO INTERFACE BD	
40	0361-32-0312	STANDOFF, HEX, M/F, NYLON, #4-40, 5/16	
41	0220-22-0440	NUT, HEX, NYLON, STANDARD, #4-40	
42	0361-32-0500	STANDOFF, HEX, M/F, NYLON, #4-40, 1/2	
43			
44	0060-00-1075-01	MODULE SPECIFICATION, MASIMO INTERFACE BOARD	
45	0060-00-1075-02	DESIGN SPECIFICATION, MASIMO INTERFACE BOARD	
46	0060-00-1075-03	WORST CASE ANALYSIS, MASIMO INTERFACE BOARD	
47	0060-00-1075-05	DESIGN VALIDATION, MASIMO INTERFACE BOARD	
48	0060-00-1075-06	PRODUCTION TEST SPECIFICATION, MASIMO IN-TERFACE BOARD	

Tone Processor Module			0670-00-1134
Item No.	**Part Number**	**Description**	**Reference**
1	0008-01-0003	TUBING HEAT SHRINK 062 ID,	
2	0008-01-0006	TUBING HEAT SHRINK 250 ID,	
3	0108-00-0067	FERRITE BEAD SMD	L1-L3
4	0136-21-0008	CONNECTOR PC HEADER RIGHT ANGLE SINGLE ROW .100 PITCH	J4
5	0136-92-0003	CONN PC HDR STR LKG PLZD 3 CKT,	
6	0155-00-2127	IC AUDIO POWER AMPLIFIER WITH SHUT-DOWN MODE	U4
7	0155-00-0875-02	IC AD7528 DUAL 8 BIT MULTIPLYING DAC	U2
8	0155-00-1010-01	IC OPA2336 OPERATIONAL AMPLIFIER	U5
9	0155-00-1040-02	IC DS1811 ECONORESET WITH OPEN DRAIN OUTPUT	U3
10	0158-05-0011	CRYSTAL CLOCK OSCILLATOR W/TRISTATE, 3.69MHZ	Y1
11	0287-00-2102	CAPACITOR SMD 0805 CERAMIC X7R 5%, 0.001UF	C9
12	0287-01-2103	CAPACITOR SMD 1206 CERAMIC X7R 5%, 0.01UF	C12,C17,C21,C22
13	0287-01-2104	CAPACITOR SMD 1206 CERAMIC X7R 5%, 0.1UF	C1,C4-C6,C8,C13-C16,C23
14	0287-02-1105	CAPACITOR SMD 1825 CERAMIC X7R 10%, 1UF	C3,C7
15	0289-01-4106	CAPACITOR SMD ELECTROLYTIC 20%, 10UF	C2
16	0324-01-1000	RESISTOR SMD THICK FILM 1/4W 1%, 100	R2,R19
17	0325-02-3002	RESISTOR THIN FILM 1/8W 0.1% 1206, 30.0K	R7
18	0326-01-1001	RESISTOR SMD THICK FILM 1/10W 1%, 1K	R3,R6
19	0326-01-1002	RESISTOR SMD THICK FILM 1/10W 1%, 10K	R1,R4,R5,R8,R10,R21,R23,R26,R27,R34
20	0326-01-1502	RESISTOR SMD THICK FILM 1/10W 1%, 15K	R25
21	0326-01-2002	RESISTOR SMD THICK FILM 1/10W 1%, 20K	R24
22	0326-01-3321	RESISTOR SMD THICK FILM 1/10W 1%, 3.32K	R32
23	0326-01-33R2	RESISTOR SMD THICK FILM 1/10W 1%, 33.2	R9,R11-R18,R20
24	0388-00-1134	PCB TONE PROCESSOR,	
25	1308-403-422	CONN HOUSING METHODE 1308-403-422,	
26	7560-05	CABLE 22 AWG 5 COND MOLEX 7560-05,	
27	0155-90-0419	MICROCONTROLLER	U1
28	0060-00-1115-01	MODULE SPECIFICATION DOCUMENT	
29	0060-00-1115-02	DESIGN SPECIFICATION DOCUMENT	
30	0060-00-1115-03	WORST CASE ANALYSIS DOCUMENT	
31	0060-00-1115-05	TEST PROTOCOL DOCUMENT	
32	0060-00-1115-06	TEST SPECIFICATION	

This page intentionally left blank.

7.0 CALIBRATION

CONTENTS OF THIS CHAPTER . . . . . Page

Status and Error Code Table

The Accutorr Plus uses the various displays on the front panel to display the operational status. Error codes listed below can generally be resolved by the user however, error codes with an asterisk (*) may require resolution by a qualified technical service person.

TYPE	CODE	DESCRIPTION	REASON
NIBP	8810	Retry - Unable to Measure	Motion artifact, cycle time-out, weak pulsations or no pulsations. A triple beep tone is generated.
	8811	Retry - Pump Higher	Insufficient cuff pressure. A triple beep tone is generated.
	8812	Stop - Cuff Overpressure	Excessive cuff pressure detected by the software. A triple beep tone is generated.
	8813	Stop - Unable to Measure	4 successive measurement attempts failed. A triple beep tone is generated.
TEMP (PTM)	8830	Check Probe	Tissue contact may have been lost.
	8831	Replace Probe	Defective probe or connection.
	8832	Battery Low	The 9V battery needs replacement.
SpO_2	8850	No Sensor	No sensor connected.
	8851	Sensor Off	Sensor not on patient. (Datascope and Masimo SpO_2 only)
	8852	Interference	Interference on signal. (Datascope and Masimo SpO_2 only)
	8853	Pulse Search	Unit cannot find signal. (Nellcor SpO_2 Module will report "Pulse Search" -8853- when the sensor is not on the patient.)
	8854	Weak Pulse	Weak pulse detected. (Datascope and Masimo SpO_2 only)
	8855	No Pulse	No pulse detected. (Datascope SpO_2 only)
	8856	Check Sensor	Sensor problem. (Datascope and Masimo SpO_2 only)
	8857	PR<30	Pulse rate is less than 30 bpm. (Datascope SpO_2 only)
	8857	PR<21	Pulse rate is less than 21 bpm. (Nellcor SpO_2 only)
	8857	PR<26	Pulse rate is less than 26 bpm. (Masimo SpO_2 only)
	8858	PR>249	Pulse rate is greater than 249 bpm. (Nellcor SpO_2 only)
	8858	PR>239	Pulse rate is greater than 239 bpm. (Masimo SpO_2 only)
	8858	PR>250	Pulse rate is greater than 250 bpm. (Datascope SpO_2 only)
SYSTEM	984*	NIBP Hardware Failure	NIBP A/D failure detected.
	985*	NIBP Overpressure Circuit not Programmed	The overpressure circuit is not set to the current patient size.
	986*	NIBP Overpressure Circuit not Tracking	The two pressure transducers are not tracking each other.
	987*	Stop - Hardware Overpressure	Excessive cuff pressure detected by hardware over-pressure sensor. A triple beep tone is generated.
	988*	TEMP Bad Calibration	Thermometer needs calibration.
	990*	TEMP Illegal Mode	Thermometer switch is set wrong.
	991*	TEMP Module Failed	Thermometer internal failure.
	995*	SpO_2 Uncalibrated	SpO_2 fails calibration check.
	996*	SpO_2 Failure	SpO_2 failed self-test.

Table 7-1 - Error Codes

7.1 INTRODUCTION

The Accutorr Plus is a state of the art device employing digital determination and verification systems to obtain superior performance for the life of the product. Most function calibration constants are written into the operating software, therefore, for the most part, there are no means to calibrate or adjust system functions. The instrument contains extensive Service Diagnostics that will, in most cases, isolate a malfunction to the lowest serviceable module.

NOTE: This procedure refers to this instrument as the UUT (Unit Under Test).

All internal verifications and adjustments should be performed with the internal battery disconnected. Operate the UUT on the main power supply. This will insure a reliable power source for the test, as well as providing a measure of safety in case of accidental overload of the power source. To re-initialize the low battery detector circuits, reconnect the battery at the conclusion of all tests while the UUT is on A.C. power source. Reset the real time clock and date, if required.

7.2 WARNINGS AND GUIDELINES

In the event that the instrument covers are removed, observe these following warnings and general guidelines:

Do not short component leads together.

Perform all steps in the exact order given.

Use extreme care when reaching inside the opened instrument. Do not contact exposed metal parts which may become live.

Read through each step in the procedure so it is understood prior to beginning the step.

7.3 TEST EQUIPMENT AND SPECIAL TOOLS REQUIRED

(Equipment types other than these listed may be utilized if they perform the required functions)

Dynatech Nevada Non-Invasive Blood Pressure Simulator (Cuff Link)

Power Supply - Power-Mate, 3A 20V

Fluke DVM - Model 8050A

Digital Storage Scope - Tektronix, 2230 100MHZ

Stop Watch - Wilson LW #19

SpO_2 Simulator - Biotek “Index”

RS232 Test Connector (pins 2 and 3 shorted) - 9 pin male “D”

700cc Dummy Cuff - 0138-00-0001-01

Chart Paper - 0683-00-0300-01

Water Bath - Cole-Palmer, model H-12-105-10

Reference Quartz Thermometer - Hewlet-Packard model HP-2804A with Temp. Probe HP-1811A

Predictive Thermometer Simulator - 0454-00-0017*

***NOTE:** *Not approved for sale to customers in CE countries.*

7.4 POWER-UP SEQUENCE, INTERNAL TESTING

1. Attach the AC power cord into the UUT rear panel AC Input Module.

2. Press the On/Standby key to turn the UUT On. The UUT automatically performs internal self diagnostics. Verify that all the LED's (Light Emitting Diodes) display a series of scrolling LED tests. After the initial power up sequence an "a" is displayed in the bed LED, a "0" is displayed in the Room LED's and "ddd" is displayed in the Systolic LED's.

3. Press the On/Standby key to turn the UUT off.

7.5 SERVICE DIAGNOSTICS

The Service Diagnostics tests must be run in the sequence indicated. Not following the tests in the order shown may result in the test failing. The numbers and letters in parentheses after the title of each test, represent the room number and bed letter used to access the test.

7.5.1 Introduction (Hidden Key)

To enter the Service Diagnostics mode, while powering on the unit, press and hold the hidden key until two beeps are heard. The hidden key is the Adult symbol above the Patient Setup key.

Verify that after the initial power up sequence a "0" is displayed in the Room LED, "a" is displayed in the Bed LED, and "ddd" is displayed in the Systolic LED's.

7.5.2 Software Version Test (0a, 0b)

This test displays the installed software version (s) in the monitor. The results are displayed in the read outs illustrated in figure 7-1.

Confirm that the ROOM number is at “0"; otherwise use the ”ROOM/BED" key to select the “ROOM”, and the Up/Down keys to set Room number to “0".

Press ROOM/BED key to select BED. Use the Up/Down arrow keys to select test “a” or “b”. Monitors without SpO_2 option may not display results for tests “0c” and “0d”. Press ROOM/BED again to lock in selection.

Press the START NIBP key.

Press the DEFLATE key until a beep is heard. This allows a selection of the next test.

Repeat process for test “b”.

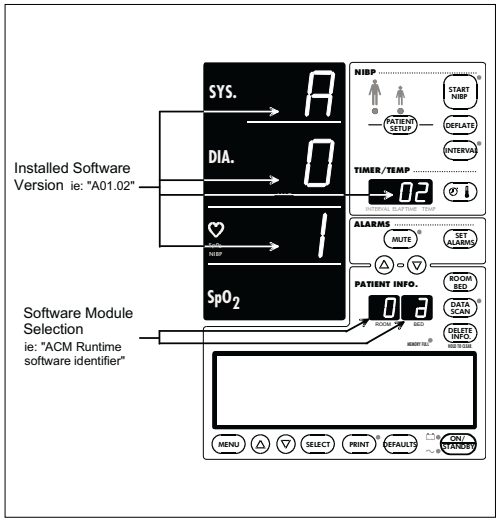


Figure 7-1 Software Version Test

Description of Software Module	Test Room Number	Sub Test Patient Bed Letter
ACM Runtime Software Version	0	a
ACM Boot Software Version	0	b
SpO_2 ACM Runtime Software Version	0	c*
SpO_2 ACM Boot Software Version	0	d*

Table 7-2

NOTE: Monitors with Nellcor® and Masimo® SpO_2 do not report SpO_2 Runtime and Boot Software Versions.

7.5.3 Keypad Test

1. Press the Room Up arrow to change the Room Number to “1"

2. Press the Start NIBP key to run the keypad test.

3. Press any key on the keyboard. A number will appear in the Patient Bed Letter Display. This number is identified in the figure 7-2. Verify that the correct number appears in the Patient Bed Letter Display when each key is pressed.

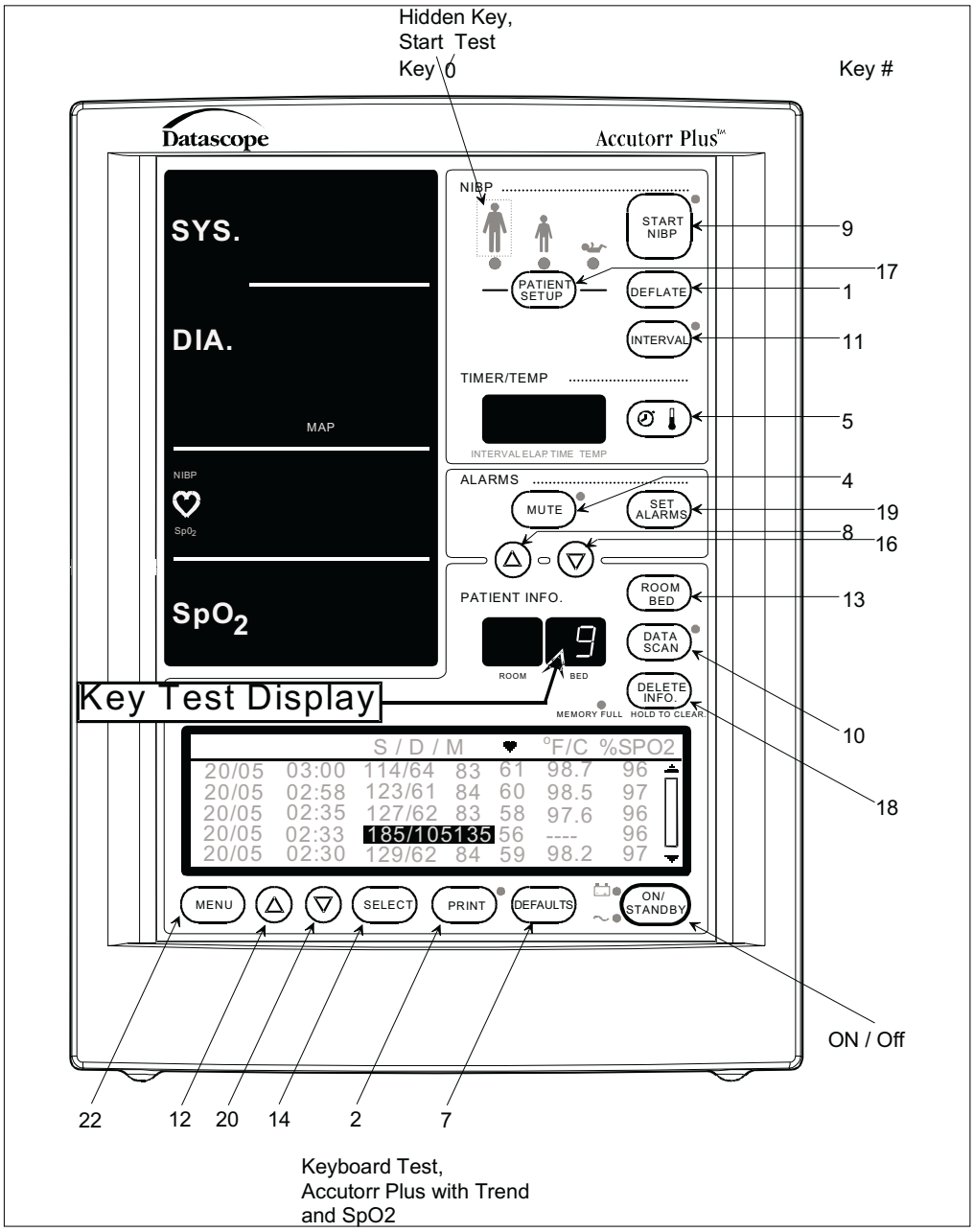


Figure 7-2

4. Press the Deflate key for 3 seconds to exit keypad test.

7.5.4 LED Test (2a, 2b)

This test allows the LED function to be verified by driving all seven LEDs with numbers from 0 to 9, in sequential order. For this test, all annunciator LEDs turn on for 1 second.

Test Description	Test Room Number	Sub Test Patient Bed Letter
7 Segment LED Test	2	a
Annunciator LED Test	2	b

Table 7-3

7.5.5 Communications Test (3a, 3b)

This test checks the integrity of the external communications systems. Test 3a checks the external RS232 interface and requires that the transmit and receive pins be connected together. Test 3b checks the Datascope Download port and requires that the tip (transmit) and ring (receive) pins be connected together. The CRC table is transmitted and received. If the CRC data received matches the CRC table transmitted, the test passes; otherwise a failure is reported.

Test Description	Short Connector Pins	Test Room Number	Sub Test Patient Bed Letter
RS232 Port Test	Transmit (2) and Receive (3)	3	a
Download Port Test	Tip and Ring	3	b

Table 7-4

7.5.6 Recorder Test (4)

1. Select Room Number 4 and press the NIBP Start key to activate the test.
   This test prints out a pattern on the recorder if a recorder module is attached. A strip similar to figure 7-3 will be printed.

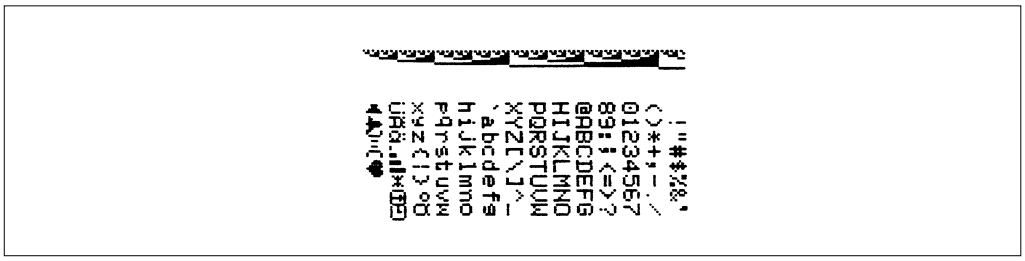


Figure 7-3

7.5.6.1 Recorder Print Head Adjustment

NOTE: This test and adjustment is performed only after a new printhead is installed.

1. Disconnect the printhead ribbon cable from the connector.

2. Check the oscillator frequency at TP-1 on the recorder control board. Proper frequency selection is determined by the printhead sensitivity. (The sensitivity rank is marked on the bottom side of the printhead flex cable, near the 90É bend in the cable.) See table 7-5.

Print Head Rank	Oscillator Output (KHz)	
	Minimum	Maximum
A	9.7	10.9
B	10.5	12.1
C	11.6	13.4

Table 7-5

3. Adjust R-1 to the correct frequency. ***PRECAUTION:*** *Increasing printhead operating frequency beyond the specified limits will shorten the printhead life or result in immediate permanent damage*.

4. Reconnect the printhead ribbon cable, and run a test strip to confirm proper print density. The print density is equally dependent on the printhead temperature, as well as on the sensitivity of the chart paper used. We recommend that the standard Datascope chart paper for this printer be used for the print test.

7.5.7 Pump Test (5)

Select Room Number 5 and press NIBP Start key to activate the test.

This test evaluates the ability of the pump to pressurize a fixed volume representative of an adult cuff to a typical adult pressure.

A fixed volume of 700 cc is pumped to a pressure of 300 mmHg. While the pump is operational, the elapsed time is displayed in the Timer/Temperature display. When the target pressure is reached, the elapsed time display holds its current reading and the pump deflates the chamber for another test. The test passes if the chamber is inflated in less than 35 seconds. Pressing the deflate key at any time during the test causes the NIBP module to open all valves and ends the test. Pressing and holding the deflate key for three (3) seconds clears the MAP display and exits the test.

Bleed Rate Test (6a, 6b)

Press the NIBP Start key to activate the selected test. See table 7-6.

This test evaluates the ability of the instrument to maintain a constant bleed rate, for the purpose of accurate and repeatable NIBP measurements. This test also evaluates **the ability of the system to reduce cuff pressure quickly.**

A fixed volume of 700 cc is pumped to approximately 20 mmHg over the specified start pressure (see table 7-6), then vented to atmosphere through one of two different valves. During the test, the MAP display indicates the real-time system pressure and the Timer/Temperature display indicates the elapsed time in seconds. When the stop pressure is reached, the MAP display is blanked and the elapsed time displays the current reading. Pressing the Deflate key ends the test and deflates the chamber. Pressing and holding the Deflate key for three seconds clears the MAP display and exits the test. Each test is uniquely identified in the Patient Bed Letter Display as described in Table 7-6. The table identifies each test, the corresponding start and stop pressures and required completion times.

Test Description	Start Pressure (mmHg)	Stop Pressure (mmHg)	Time (Sec.)	Test Room Number	Sub Test Patient Bed Letter
Linear Bleed Valve Test	180	60	15-25 seconds	6	a
Dump Valve Test	250	20	14 seconds max.	6	b

Table 7-6

7.5.8 Leak Test (7)

Select Room Number 7 and press the NIBP Start key to activate the test.

This test evaluates the ability of the system to maintain a steady pressure.

A fixed volume is pumped up to an initial differential pressure of approximately 250 mmHg and monitored for a fixed period of time. While the pump is operational, peak pressure is displayed in the MAP display. When the target pump pressure is reached, the peak pressure is frozen in the MAP display during a five second dwell. During leakage measurement, the current pressure leakage is displayed in the MAP display and the elapsed test time (in seconds) is displayed in the Temperature/Time/Interval display. After the leakage measurement time has elapsed, the MAP and Temperature/Time/Interval displays are blanked and a “00” (Pass) or “FF” (Fail) will be displayed in the Bed window. Pressing the Deflate key at any time during the test causes the NIBP module to open all valves and ends the test. The maximum pressure drop shall be no more than 10 mmHg in any 90 second period when connected to a 700 cc volume.

Pressing the Deflate key ends the test and deflates the chamber.

Pressing and holding the Deflate key for three seconds clears the MAP display and exits the test.

7.5.9 Over Pressure Test (8a, 8b, 8c)

Select Room Number and Bed Letter per table 7-7. Press the NIBP Start key to activate the test.

This test evaluates the ability of the system to prevent an over pressure condition, independent of software control, for each of 3 over pressure settings. A fixed volume of 700 cc’s is pumped to a target pressure that is above the maximum over pressure specified

for the respective over pressure limit (see table 7-7), while displaying the real-time system pressure in the MAP display. For this test, the software over pressure monitor is disabled. On completion, the MAP display indicates the maximum pressure reached and the Patient Bed Letter Display indicates if the over pressure sensor was activated (00) or not (FF). Pressing the Deflate key at any time during the test causes the NIBP module to open all valves and ends the test.

Following each over-pressure hardware test, the UUT must be turned off in order to re-enable the pump.

Test Size/Mode	Target Pump Pressure (mmHg)	Test Room Number	Sub Test Patient Bed Letter
Low	157, ±5	8	a
Medium	210, ±10	8	b
High	315, ±15	8	c

Table 7-7

7.5.10 Pulse Channel DC Offset Test (9a, 9b, 9c)

Select Room Number and Bed Letter per table 7-8, and press the NIBP Start key to activate the test.

This test measures the DC offset for each of the three electronic gain settings available on the pulse channel. Results for each gain setting are displayed in the Timer/Temperature display (in Volts). Table 7-8 describes the tests performed.

Test Description	Acceptable Limit (V)	Test Room Number	Sub Test Patient Bed Letter
Gain 1 (Low) Test	1.50 to 1.83	9	a
Gain 2 (Med) Test	1.50 to 1.83	9	b
Gain 3 (High) Test	1.50 to 1.83	9	c

Table 7-8

7.5.11 Pulse Channel Average Noise Test (10a, 10b, 10c)

Select Room Number and Bed Letter per table 7-9, and press the NIBP Start key to activate the test.

This test measures the average noise for each of three electronic gain settings available on the pulse channel. Results for each gain setting are displayed in the Timer/Temperature display (in millivolts). Table 7-9 describes the tests performed.

Test Description	Acceptable Limit (mV)	Test Room Number	Sub Test Patient Bed Letter
Gain 1 (Low) Test	<25	**10**	a
Gain 2 (Med) Test	<50	**10**	b
Gain 3 (High) Test	<75	10	c

Table 7-9

7.5.12 Main Pressure Transducer Verification Test (11a, 11b, 11c)

This tests the calibration of the main pressure transducer in LOW, MED, and HIGH modes. This is done by comparing the readings of the UUT to an external pressure gauge in LOW mode below 100 mmHg, in MED mode between 100 mmHg to 200 mmHg, and in HIGH mode between 200 mmHg to 300 mmHg. In the event of a disagreement between the device and an external gauge, the transducer must be calibrated by performing the calibration in section 7.5.15 Main Pressure Transducer Calibration.

1. Select diagnostic test "11" (Room) "a" (Bed).

2. Press the Start NIBP key to start LOW calibration test. Verify that the pump comes on, the pressure increases, and then the pump stops. After 10 seconds, verify that the pressure settles below 100 mmHg. Compare the final pressure displayed to an accurate (±0.2%) external pressure gauge. The MAP LEDs reading should agree within ±1% with the external pressure gauge. If it does not agree, a failure has occurred and proceed to 7.5.15 Main Pressure Transducer Calibration.

3. Press the Deflate key to release the pressure and exit the test.

4. Select diagnostic test "11" (Room) "b" (Bed).

5. Press the Start NIBP key to start the MED calibration test. Verify that the pump comes on, the pressure increases and then the pump stops. After 10 seconds verify that the pressure settles between 100 mmHg and 200 mmHg. Compare the pressure displayed to an accurate (±0.2%) external pressure gauge. The pressure MAP LEDs reading should agree within ±1% with the external pressure gauge. If it does not agree, a failure has occurred and proceed to 7.5.15 Main Pressure Transducer Calibration.

6. Press the Deflate key to release the pressure and exit the test.

7. Select diagnostic test "11" (Room) "c" (Bed).

8. Press the Start NIBP key to start HIGH calibration test. Verify that the pump comes on, the pressure increases, and then the pump stops. After 10 seconds, verify that the pressure settles between 200 mmHg and 300 mmHg. Compare the final pressure displayed to an accurate (±0.2%) external pressure gauge; the MAP LEDs reading should agree within ±1% with the external pressure gauge. If it does not agree, a failure has occurred and proceed to 7.5.15 Main Pressure Transducer Calibration.

9. Press the Deflate key to release pressure and exit the test.

7.5.13 Verification of Accutorr Plus Pneumatic Performance, using the "Cufflink" NIBP Simulator (11d)

Select Room Number 11 and Bed Letter d, and press the NIBP Start key to activate the test.

For these tests, program the Cufflink NIBP simulator to perform the desired test. Instead of pumping up the cuff, this test uses the Cufflink simulator to verify the Accutorr pressure reading for the NIBP Leak Test, Over Pressure test, and the Main Pressure Transducer Verification Test. The Accutorr displays the pressure in the MAP display.

Pressing the Deflate key at any time during the test causes the NIBP module to open all valves and ends the test. Pressing and holding the Deflate key for three seconds clears the MAP display and exits test. The Cufflink simulator must be exited separately.

NOTE: The reading and setting accuracy will be dependent on the accuracy of the Cufflink calibration and the Accutorr Plus condition.

The Cufflink standard dynamic pressure simulation may produce Systolic / Mean / Diastolic read outs on the Accutorr Plus outside of the specified limits. The pressure simulation results may not be accepted as a measure of the Accutorr Plus clinical performance.

7.5.14 Over Pressure Transducer Verification (12c, 12a, 12b)

This test verifies that the over-pressure transducer is calibrated correctly. Calibration is checked in the Low level pressure mode so that the limit displayed in the MAP window should say 158 mmHg (±1). If it does not, the transducer needs to calibrated by proceeding to 7.5.16 Over-pressure Transducer Calibration. The over-pressure transducer should also be verified in the High and Mid level pressure modes.

1. Select diagnostic test “12” (Room) “a” (Bed). Low Limit

2. Press the Start NIBP key to start the test.

3. Verify that the over-pressure value displayed in the MAP LEDs is 158 mmHg (±1).

4. Repeat steps 1 through 3, but select test “12” “c” to check over-pressure limit, 315 mmHg (±15); and test “12” “b” for Mid level over-pressure limit, 210 mmHg (±10).

5. Press the Deflate key to exit this test.

7.5.15 Main Pressure Transducer Calibration

NOTE: This procedure should only be performed in the event that there was a failure in 7.5.12 Main Pressure Transducer Verification.

This is the procedure for calibrating the main pressure transducer in the event that there is a disagreement between the UUT and the external pressure gauge in the proceeding test. The device is calibrated by comparison with the Cufflink simulator at 158 mmHg (±1) and then by adjusting R40 on the 0670-00-0584-01 PCB.

1. Connect the Cufflink simulator to the Accutorr Plus cuff connector, and connect a 700 cc test chamber to the open port of the simulator. Select the manometer function of the simulator.

2. Select diagnostic test “11” (Room) “d” (Bed).

3. Press the Start NIBP Key to start HIGH calibration procedure.

4. Pump up the Cufflink simulator to 158 ±1mmHg.

5. Allow pressure to stabilize for 10 seconds. Read the pressure in the MAP display.

6. Adjust R40 on the 0670-00-0584-01 PCB until the MAP readout is the same as the simulator's manometer reading.

7. Press the Deflate key to exit this test.

8. Repeat 7.5.12 Main Pressure Transducer Verification.

7.5.16 Over Pressure Transducer Calibration

NOTE: This procedure should only be performed if a failure occurred in steps 1 through 3 of 7.5.14 Over-Pressure Transducer Verification.

This is the procedure for calibrating the over-pressure transducer in the event that the display does not read 158 mmHg during the test for Low pressure mode in 7.5.14 Over Pressure Transducer Verification. The transducer is calibrated using R4,on the 0670-00-0584-01 PCB.

1. Adjust R4, on the 0670-00-0584-01 PCB until MAP read out is 158 mmHg.

2. Repeat 7.5.14 Over Pressure Transducer Verification.

7.5.17 Battery Selection (13)

This section will allow the user to configure the unit for a Sealed Lead Acid or Lithium Ion battery.

1. Select diagnostic test (Room) "13".
2. Press the Start NIBP to enable the selection process. The pump will NOT start up.
3. The Diastolic display will show the currently configured battery type. Sealed Lead Acid will be represented by "La" and Lithium Ion will be represented by "Li".
4. Using the Patient Info Up/Down arrow keys, select the appropriate battery type.
5. Press the Deflate key to confirm your choice. If the Deflate key is not pressed, the change will not take effect.

7.6 PREDICTIVE THERMOMETER VERIFICATION AND CALIBRATION

The first, Temperature Accuracy Verification with the Predictive Temperature Simulator, is a very quick method to confirm that the PTM is operating within the specified limits. The PTM simulator is a Datascope proprietary test device, available for purchase from the company. The Predictive Temperature Simulator (P/N 0454-00-0017) has not been released for sale to customers in CE countries.

The second method, called the Water Bath Method, utilizes laboratory grade stirred water bath to confirm that the PTM is operating within the specified limits.

In case of failure or inaccuracy of readings, the System Calibration Procedure may be followed to re-adjust the device to factory specifications.

This procedure requires high accuracy test equipment and therefore it is not recommended for field calibration. Datascope offers a comprehensive factory service program to support this product."

7.6.1 Temperature Accuracy Verification with the Predictive Temperature Simulator

1. Measure the battery in the Predictive Thermometer module, verify that the voltage is 8.6 V or greater. **NOTE:** Newer modules do not contain a 9V battery. Skip this step.

2. Install the Predictive Temperature Module onto the Accutorr Plus and turn on the monitor.

3. Remove the temperature probe from the probe holder and disconnect the connector from the Predictive Thermometer module. Connect the Predictive Temperature Simulator.

4. Select 85.0 F (29.4 C) and push the *"Push to cycle PTM"* button to reset the PTM.

5. Note the resultant display in the TIMER/TEMP window on the Accutorr Plus. It should be 85.0 F (29.4 C).

6. Press the *"Push to cycle PTM"*. Select the next higher temperature, 98.5 F (37.0 C). Since this is a predictive device with "look ahead" algorithm, it is important to read only the second number flashed on the display. The first, third or subsequent flashing readings may be outside of the limits. Return to 85.0 F (29.4 C).

7. Repeat step 6 for the remaining temperatures. Record the test results. All readings must be within 0.1 (F/C) degrees of simulator settings.

8. Disconnect the Predictive Temperature Simulator, and connect the normal temperature probe. Insert, then remove the probe from the probe holder. This will reset the PTM, and flash an initial value of 85.0 F or 29.4 C.

7.6.2 Water Bath Method

1. Prepare a water bath set to 89.6 to 110.0 F as a temperature reference. Confirm temperature with a separate precision thermometer.

2. Snap a protective sheath onto the temperature probe, and immerse into the reference water bath for 30 seconds, or until the temperature display stops flashing. Record the temperature shown on the temperature display.

3. Apply the correction factor, shown in table 7-13, to obtain the calibrated measurement.

Celsius Readouts		Fahrenheit Readouts	
Range	Subtract	Range	Subtract
32.0 to 41.0	0.6	89.6 to 102.0	1.1
41.0 to 43.0	0.5	102.1 to 106.0	1.0
		106.0 to 110.0	.5

Table 7-13

4. Compare readouts after correction factors are calculated. Proceed to System Calibration Procedure if readings are out of specification.

7.6.3 System Calibration Procedure

1. Connect a fresh 9 volt battery or an external power supply set to 9 .1V to the predictive thermometer. **NOTE:** Newer modules do not contain a 9V battery. Skip this step.

2. Set SW2-3 to closed position (the switch is towards the PCB). Connect resistor decade box to the temperature probe connector. Set the decade box to 8343 ohms, 2 ohms. **NOTE:** (All other settings of SW2 should be in the open position; away from the PCB.)

3. Connect the DVM to J4-2 (-) and J4-7 (+) output jacks.

4. Jumper J4-2 and ground terminal (J2-1) jacks.

5. Switch power supply on.

6. Adjust R1 until a reading of 100 mV, 5 mV is on the DVM.

7. Adjust the decade box to 4746 ohms, 2 ohms. Record the voltage displayed on the DVM.

8. Connect the DVM + lead to J4-4. Adjust R2 until the DVM reading is the same as the one recorded in step "7", 1mV.

9. Remove all jumpers and test leads. The calibration is completed.

10. **Set** the decade box back to 8343 ohms. Power cycle the unit (switch off then on). The initial start-up temperature of 85.0°F should be displayed.

7.6.4 Temperature Verification Test, Infrared Thermometer (applicable only to units equipped with a temperature option)

1. Pre-heat water bath to 100 F. Place floating Black Body device into water bath and allow to stabilize until step 7, or a minimum of 30 seconds.

2. Prepare the thermometer for the verification process, by removing any disposable probe covers. Clean the probe lens with a swab dipped in alcohol.

3. Completely cover probe tip with a piece of aluminum foil, from the lens to the probe neck portion. Allow 5 minutes for the probe and foil to stabilize at ambient temperature.

4. Activate the thermometer, by pressing the button. Read the ambient temperature displayed and record the number as T_A=____.

5. Remove the aluminum foil.

6. Check the water bath temperature against a laboratory grade mercury thermometer, with a verified accuracy of 0.4 F (0.2 C) or better. Record the water bath temperature as TT=___.

7. Attach a disposable probe cover to the thermometer head. Insert the head into the floating Black Body cavity, such that the instrument is looking into the needle shaped end.

8. Press the button to measure the temperature. Record the temperature as T_{DCALC}=____.

9. Select the appropriate correction factor from the following choices:
   Core temperature correction: Kcore=1.087

   Oral temperature correction: Kora=1.058

   Rectal temperature correction: Krectal=1.095

   The standard Datascope infrared thermometer is calibrated to indicate Core temperature, thus the correction factor to be used is K=1.087.

10. Calculate the display temperature according to the following formula:
    $K(T_T-T_A)+ T_A = T_{dcalc}$ where:

    T_{dcalc} is Calculated Display Temperature.

    K_{core}=1.087 Correction Factor for Core Temperature.

    T_T is Target Temperature.

    T_A is Ambient Temperature.

    Sample Calculation:

Ambient temperature (T_A) measured: 72 F

Water Bath temperature ($T_{T)}$ measured: 98.6 F

Correction Factor (K_{core})=1.087

1.087 (98.6-72) + 72= 100.9 F thus,
Temperature displayed by thermometer is 100.9 F, and calculated temperature is 100.9 F, the accuracy has been verified.

Temperature value deviations: The calculated value is a function of the accuracy of the water bath temperature. As an example, a 1% reading error of water temperature will result in a 1 F reading input into the formula, resulting in a final calculated values of 99.9 to 101.9 F.

With a display resolution of 1 digit and an over all resolution of 0.2 F, the final, calculated reading may fall between 98.6 and 102.2 .

7.6.5 Low Battery Sensing

The low battery threshold is not adjustable. When the battery has reached the low battery threshold, U4 and Q2 report this condition to the CPU on the Accutorr Plus.

7.7 BATTERY TEST FOR ACCUTORR PLUS

NOTE: During this test, the real time clock will reset.

1. Disconnect the cable from the battery and remove the AC power cord from the UUT. Connect the power supply positive output to the battery cable positive terminal and the negative power supply terminal to the negative terminal of the battery cable. Set the power supply voltage to 14.5, .1 volts for SLA battery, 12.5 .1 volts for Li-Ion battery.

2. Press the On/Standby key to power up UUT. Verify that the normal power up sequence as described in this document occurs and that the indicator for the battery symbol on the keypad is lit.

7.7.1 Low Battery Indicator and Low Battery Cut-Off

CAUTION: *During this test, the real time clock will be reset and any Trend information will be lost. Temporary user preference settings will also be erased.*

Power Supply requirement: the power source used for testing needs to source 0 to 15 VDC and able to withstand current spikes of 3 to 4 Amperes without current or voltage sags.

1. Remove the battery pack and AC mains cord. Remove monitor rear cover. Disconnect the Battery Connector cable from the power supply.

2. Set the external power supply voltage to 14.5 VDC, current limit set to 4 Amps. Connect the positive of the external power supply to the input side of the F3 fuse. (4 A) Connect the negative side of the external power supply to the negative pin of the Accutorr Plus power supply or to the chassis near the battery connector.

3. Connect a DVM to the load side of F3 of the Accutorr Plus power supply and the chassis of the Accutorr Plus. This method will read the actual voltage applied to the internal power supply and will be the reading used to determine the Low Battery Indicator and Low Battery Cut-Off voltages.

4. Turn the monitor ON, and allow to complete the self check initialization.

5. Slowly decrease the external power supply voltage, in approximately 100 mv. steps, every 0 seconds. Note the voltage where the Battery LED begins to flash. Note this voltage and compare to the specification in the following table. Continue to decrease the voltage until the monitor turns off. This is the Low Battery cut-off voltage. Note this voltage and compare to the specification in the following table.

Type of Battery Installed	Low Battery Indicator limits	Low Battery Cut-Off limits
Sealed Lead Acid	10.95 to 11.63 VDC	9.8 to 10.7 VDC
Lithium Ion	9.95 to 10.61 VDC	8.7 to 9.5 VDC

6. Turn the monitor Off, re assemble and install the battery pack.

7.7.2 Set the Current Time

1. Press and hold the Timer/Temp key for 3 seconds. The hour digit only displays.

2. Press the Up or Down Arrow key to change the number.

3. Press the Timer/Temp key to activate the minute display.
NOTE: The Accutorr Plus always displays time in a 24 hour format.

4. Press the Up or Down Arrow key (12 or 13) to change the number. Continue pressing the Timer/Temp key and the Arrow keys to set the month, day, and year (in that order).

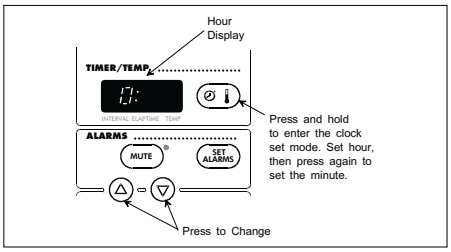


Figure 7-3 - Hour Display

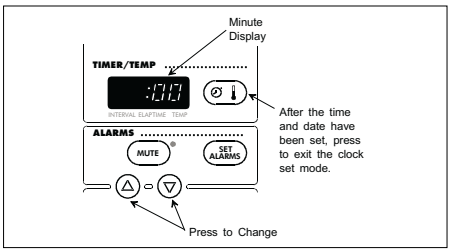


Figure 7-4 - Minute Display

7.8 NIBP NORMAL OPERATION

1. **Press the left arrow key on the "Cufflink" Simulator to highlight SELECT BP, then press the ENT key. Set pressure test to 120/80 (90) and press the ENT key.**

2. Attach the simulator "Cufflink" to the input pressure fitting of UUT.

3. Press the interval key of the keypad until a 1 is shown in the Timer/Temp./Interval LED of the UUT. Press the Patient Size key to select Adult size indicator.

4. Press the Set Alarms key to enter the alarm setting mode. Use the Up and Down arrow keys to set the Systolic Low alarm to 115 mmHg.

5. Press the Set Alarms key again and set the Diastolic Low Alarm to 95 mmHg.

6. Press the Start NIBP key. Verify the monitor takes a measurement and the Systolic and the Diastolic low alarms are violated. The LED's for these parameters will blink on and off and an alarm tone will sound for the violation. Press the Mute Key to silence the alarms.

7. After the fifth measurement is complete, allow the cuff to pump up. Press Deflate key. Verify cuff deflates.

8. Review the data that was stored in the database, by scrolling through the patient trend information. Use the Up and Down Room and Bed keys or LCD display of the UUT and verify that the Systolic and Diastolic information is available in the LED's for each stored settings

9. Remove the cuff from the UUT and press the Start key. Confirm that the UUT pump runs and that it displays a "-10" in the Systolic LED within 60 seconds and attempts another inflation. Press the Deflate key to stop test.

7.9 TREND MEMORY INITIALIZATION

1. To clear the UUT Trend Memory for all patient settings, press and hold the Delete Info. key while powering up the unit.

7.10 SpO_2 NORMAL OPERATION (Accutorr Plus model with SpO_2)

NOTE: This procedure can be accomplished with the Biotek "Index" SpO_2 simulator or an equivalent SpO_2 simulator.

The purpose of this test is to verify that an SpO_2 signal is recognized, alarm limits are captured and the data is trended. A full operational test may be conducted, if so warranted, within the limits of the published specification. See chapter 3 of this manual for specifications.

1. Set the simulator to an SpO_2 saturation level of 98%, pulse rate of 60 bpm, and a pulse amplitude of 100%.

2. Set the Accutorr Plus SpO_2 HI alarm limit to 95% and the pulse rate HI alarm limit to 55 bpm.

3. Connect an NIBP cuff or a suitable simulator to the Accutorr Plus and start a measurement.

4. Confirm that the Accutorr Plus has determined an SpO_2 saturation level and has violated the SpO_2 HI alarm and the pulse rate HI alarm (flashing digits and alarm tone). Press the MUTE key to silence the alarms.

5. Check the trend screen to confirm that the measurement information has been saved.

6. Set the SpO_2 HI alarm to OFF and SpO_2 LOW alarm to 86.

7. Set the simulator to an SpO_2 saturation level of 90%, pulse rate of 95 bpm, and the pulse amplitude to approximately 10% (Weak Pulse Datascope SpO_2 only, low perfusion Masimo SpO_2 only).

8. The Accutorr Plus may intermittently determine SpO_2 values or indicate a status code of 8853 (Pulse Search) or 8854 (Weak Pulse / Low Perfusion will display). Adjust the simulators pulse amplitude up and down until either status code of 8853 or 8854 displays.

9. Restore normal simulation parameters as described in step 1.

10. Remove the sensor from the simulator to induce a status code of 8851 (Sensor Off Datascope SpO_2 or Masimo SpO_2 only).

11. Disconnect the sensor from the Accutorr Plus to produce a status code of 8850 (No Sensor).

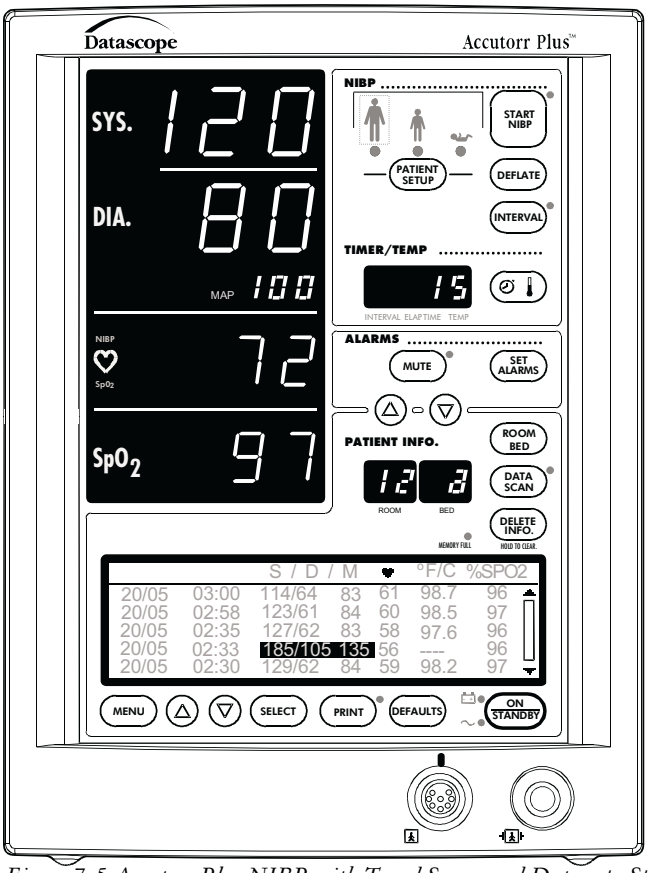


Figure 7-5 Accutorr Plus NIBP with Trend Screen and Datascope SpO_2

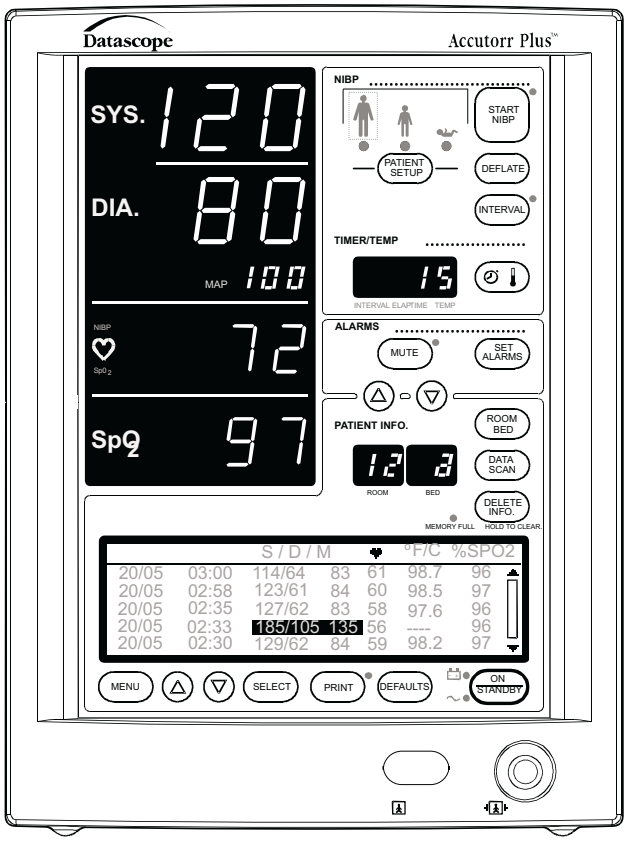


Figure 7-6 Accutorr Plus NIBP with Trend Screen and Nellcor® or Masimo® SpO_2

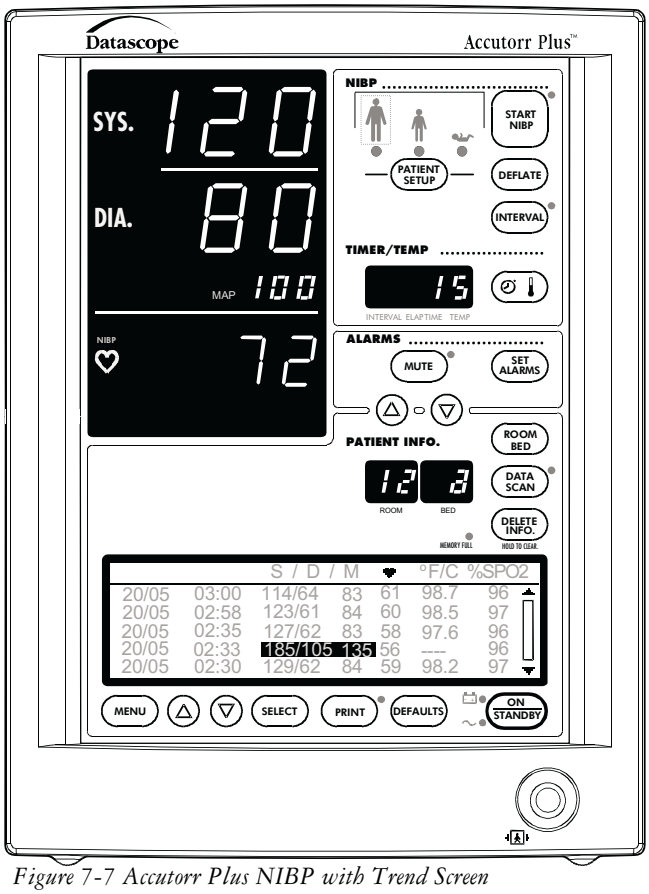


Figure 7-7 Accutorr Plus NIBP with Trend Screen

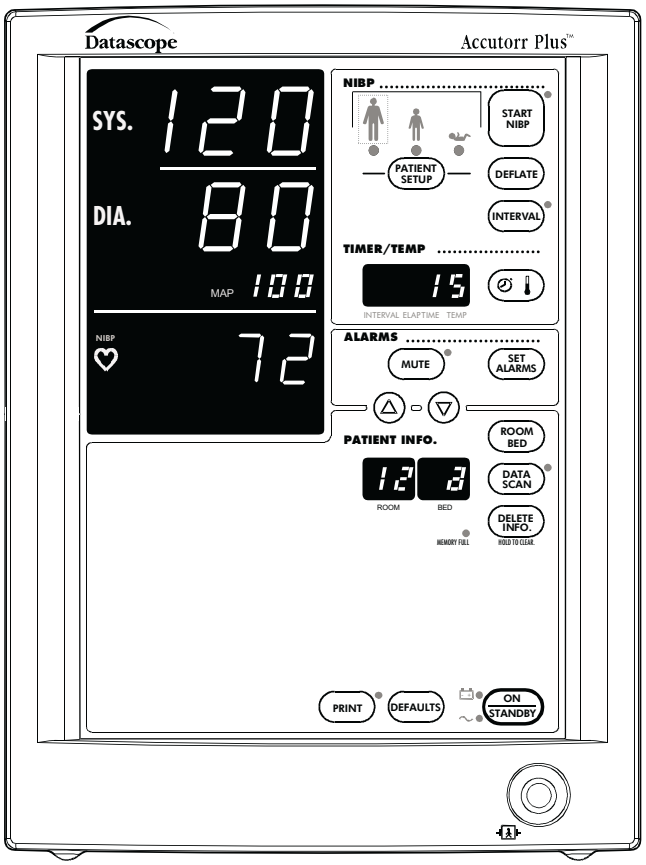


Figure 7-8 Accutorr Plus NIBP

This page intentionally left blank.

8.0 PREVENTIVE MAINTENANCE

CONTENTS OF THIS CHAPTER . . . . . Page

8.1 INTRODUCTION

The intent of this procedure is to ensure that the product continues to be safe and effective in it's intended environment. Complete knowledge of the instrument characteristics and it's relationship to the clinical environment are useful in determining changes in the performance of the monitor, and the clinical limitations of the device.

As a general rule, the instrument is not tested to the full limits of it's capabilities at each service interval. Rather, representative points are tested and the results recorded. It is important to note that while not all functions are tested to the absolute limits, every function and option should be exercised. Declining performance over time is frequently the first indication of the need for more extensive service action.

8.2 LIMITATIONS OF PHYSIOLOGICAL SIMULATORS

The physiological simulator is the principle aid for problem solving. Simulators have many of the same limitations as the devices that they will test. It is imperative that the simulator correlate well to a "Reference Standard*". The electronic simulators available attempt to replicate a broad spectrum of indices representative of normal and abnormal physiological events, within the interpretation of the manufacturer.

Most simulators (properly maintained) will provide reasonably accurate and consistent results, but may not produce the exact results when connected to similar monitors from different manufacturers. However, the consistent performance of a simulator is a good indicator of any change in the performance in the monitor.

** For example, an accurate mercury column for pressure verification.*

8.3 PREVENTIVE MAINTENANCE SCHEDULE

The following preventive maintenance steps are required for continued satisfactory performance and safety of the Accutorr Plus and optional accessories. Inspections and replacement of consumable supplies and accessories that are subject to normal wear, must be accomplished at least as frequently as the inspection of the host unit. Read the Warranty statement in the Operating Instructions for description of warranty conditions.

The suggested minimum maintenance schedule is based on normally expected wear and tear of system and components. The intervals may be shortened at the user's discretion when conditions of use may warrant. In case of internal instrument failure, component replacement, and possible or actual instrument damage, it is strongly recommended that complete performance and safety verification be conducted.

8.3.1 Mechanical and Physical Visual Inspection (One Year Interval)

Check the following items for wear and physical damage: Repair or replace as needed.

- Outer case of Accutorr Plus, Recorder and Temperature module.
- Patient connected accessories such as blood pressure cuffs and hoses and related connectors. Check the SpO_2 sensor and cables. Check the temperature cables and probes. Verify and replenish the disposable items as needed. (IE: probe covers, recorder chart supply).
- Power cords, external safety ground connections and communication cables.

8.3.2 Electrical Safety and Performance Checks (One Year Interval)

- Line power and battery power indicator lights functional in the proper modes.
- Line power and safety grounds are intact and within specifications.
- Non-invasive blood pressure section is functional within specifications.
- SpO_2 functions are operational and within specification.
- Temperature functions are operational and within specifications. Check the temperature module battery voltage under load: replace if under 8.8 V. Use only alkaline batteries. **NOTE:** Newer PTM modules do not contain a 9V battery.
- Recorder is functional and documents available stored data.
- Error codes, failure messages, end user reported anomalies are collected and analyzed for reduced performance trends. Identify and correct causes as warranted.
- Check recorder paper path and clean as required.
- Perform ground resistance and chassis leakage tests.

This page intentionally left blank.

Printed in U.S.A. *0070-10-0429* *Rev AC* *September 20, 2007*

Mindray DS USA, Inc. • 800 MacArthur Boulevard • Mahwah, NJ 07430 • USA •
Dom. Customer Service: 1.800.288.2121 • Intl. Customer Service: +1.201.995.8000 •
Dom. Fax: 1.800.926.4275 • Intl. Fax: +1.201.995.8680 • www.mindray.com

Mindray Medical Netherlands B.V.• P.O. Box 26 • 3870 CA Hoevelaken • The Netherlands •
Tel: +31 33 25 44 911 • Fax: +31 33 25 37 621

Mindray (UK) Limited • 3 Percy Road • St. John's Park • Huntingdon • Cambridgeshire PE29 6SZ •
United Kingdom • Tel: 01480 416840 • Fax: 01480 436588

Mindray Medical France SARL • Europarc Créteil •123, Chemin des Bassins •
94035 Créteil Cedex • France • Tel: (0)1.45.13.91.50 • Fax: (0)1.45.13.91.51

Mindray Medical German GmbH • Zwischen den Bächen 4 • 64625 Bensheim • Germany •
Tel: +49.6251.17524-0 • Fax: +49.6251.17524-20

Mindray Medical International Ltd. • 2813 Office Tower, Convention Plaza • No 1 Harbour Road •
Wanchai • Hong Kong • Tel: +852 2793 5596 • Fax: +852 2344 8824